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DEHNR RALEIGH REGIONAL OFFICE

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September 29, 1995

Mr. Robert Walton North Carolina Division of Environmental Management Raleigh Regional Office 3800 Barrett Dr., Suite 101 Raleigh, NC 27609

Re: Corrective Action Plan Addendum
Nello Teer - Durham Quarry
Durham, North Carolina
Ground Water Incident No. 9537
Front Royal Project No. 0013-94-012

Dear Mr. Wilson:

Please find enclosed the Corrective Action Plan Addendum for the Nello Teer Company Durham Quarry located at 5013 Denfield Drive (State Road 1641) in Durham County, North Carolina.

If you have any questions regarding this matter please contact me at (919) 469-9795.

Sincerely,

FRONT ROYAL ENVIRONMENTAL SERVICES, INC.

Bryan/C. Gee, P.E. Senior Project Manager

R95-053.BCG:les

OFFICE ACTION PLAN OFFICE

DIVISION OF ENVIRONMENTAL MANAGEMENT

CERTIFICATION FOR THE SUBMITTAL OF A CORRECTIVE ACTION PLAN

UNDER 15A NCAC 2L.0106(c)

Responsible Party:

Address:
City:

Nello Teer Company
Post Office Box 13983
City:

R.T.P., State: NC, Zip Code: 27709-3983

Site Name:
Address:
Outputham
City:
Durham
Co::
Durham, Zip Code:
Groundwater Section Incident Number: 9537

I, Bryan C. Gee , a Professional Engineer/Licensed Geologist (circle one) for Front Royal do hereby certify that the information indicated below is enclosed as part of the required Corrective Actin Plan (CAP) and that to the best of my knowledge the data, site assessments, engineering plans and other associated materials are correct and accurate.

(Each item must be initialed by hand by the certifying licensed professional)

A listing of the names and addresses of those individuals required to be notified to meet the notification requirements of 15A NCAC 2L .0114(a) is enclosed. Copies of letters and certified mail receipts are also enclosed.

A Professional Engineer or Licensed Geologist has prepared, reviewed, and certified all applicable parts of the CAP in accordance with 15A NCAC 2L .0103(e).

A site assessment is attached or on file at the appropriate Regional Office which provides the information required by 15A NCAC 2L .0106(g).

CSA Submitted October 1993

A description of the proposed corrective action and supporting justification is enclosed.

Specific plans and engineering details for the restoration of groundwater quality are enclosed and propose the use of the best available technology for the restoration of groundwater quality to the levels of the groundwater standards prescribed in 15A NCAC 2L .0202.

6. A schedule for the implementation and operation of the CAP is enclosed.

7. A monitoring plan is enclosed which has the capacity to evaluate the effectiveness of the remedial activity and the movement of the contaminant plume, and which meets the requirements of 15A NCAC 2L.0110.

8. The activity which resulted in the contamination incident is not permitted by the State as defined in 15A NCAC 2L .0106(e).

(Please Affix Seal and Signature)



Note: Any modifications made to this form may result in the return of your submittal.

GW-100(c) Rev. 9/94

Corrective Action Plan Addendum
Nello Teer Quarry
Denfield Road
Durham, North Carolina
September 29, 1995

Prepared for

Nello Teer
Denfield Road
Durham, North Carolina
Front Royal Project No. 0013-94-012

Prepared by

Front Royal Environmental Services, Inc. P.O. Box 4350 Cary, North Carolina 27519

Bryan C. Gee, P.E.

Senior Project Manager

Bruce D. Reilly, P.E.

Engineering Department Manager

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Corrective Action Plan Addendum Nello Teer Quarry Denfield Road Durham, North Carolina Front Royal Project No. 0013-94-012 September 29, 1995

1 Introduction

1.1 Site Data

This Corrective Action Plan Addendum is prepared by Front Royal Environmental Services, Inc. (Front Royal) to initiate remediation of ground water and soil contamination at the Teer Company (Teer) Durham Quarry, located at the end of Denfield Street (State Road 1641) in Durham, North Carolina (the site). The site is located in the Northwest Durham Quadrangle (Figure 1). The original December 1993 CAP was prepared by Geonetics, Inc. (Geonetics) and submitted to the North Carolina Department of Environmental Management (NCDEM). Front Royal has been retained by Teer to evaluate work completed by Geonetics, and to develop and implement a soil and ground water remedial system based on data previously collected by Geonetics and current site conditions. Revisions to the December 1993 CAP are presented in this report.

The site has been in operation as a crushed stone quarry and processing plant since the 1940s. Originally, the site was owned and operated by the North Carolina Department of Transportation (NCDOT). The NCDOT operated the quarry, as well as an asphalt batch plant. In 1951 the property and facilities were sold to the Teer Company. The asphalt plant has since been closed and relocated to another site.

The site has been impacted by two sources. The first source is a fuel underground storage tank (UST) area that was in use at an onsite service station at the southern property boundary. The second source is the asphalt plant that was formerly located at the site. The NCDEM has assigned Ground Water Incident Number 9537 and Site Facility Number 0-012984 to the site.

1.2 Purpose

On October 2, 1992 ground water laboratory analytical data from onsite water well W-1 were submitted to the Raleigh Regional Office of the NCDEM. The data indicated that contaminants in excess of North Carolina Water Quality Standards (15A NCAC 2L .0202) were present in the water supply well. In response, the NCDEM issued a Notice of Violation to Teer on January 25, 1993. The purpose of this CAP is to further develop a strategy for the remediation of impacted soil and ground water at the site.

Ground water and soils at the site have been impacted by a petroleum hydrocarbon release from fuel USTs that were located at the site service station. In addition, soils have been impacted by operations that took place at the former asphalt plant and ground water. The affected ground water at the site falls under class GA of the North Carolina Ground Water Standards.

1.3 Summary of Actions to Date

In December 1988, Teer removed one 3,000-gallon gasoline UST, two 4,000-gallon gasoline USTs, one 10,000-gallon gasoline UST, and two 10,000-gallon diesel USTs that had been in use at the service station. To determine the extent of potential soil and ground water contamination, Teer contracted Geonetics to conduct a Comprehensive Site Assessment (CSA) and prepare a CAP based on the findings of the CSA. During the course of the site investigations, 25 monitor wells were installed to assess ground water contamination (Figure 2).

In addition to installing ground water monitor wells, Geonetics conducted multiple soil boring programs to evaluate potential soil contamination at the site (Figure 3). One of the primary areas of soil contamination was determined to be along the south side of the quarry pit where the former asphalt plant was located (Table 1). The highest levels of soil contaminants were detected in the top layer of soils. In addition, isolated pockets of soil contamination were detected in the vicinity of the former service station, the current truck shop, and east of the former service station along the southern property boundary.

Laboratory analytical results from the former service station area indicate total petroleum hydrocarbons (TPH) as diesel fuel was detected in the soils at levels in excess of state action limits. The highest contaminant levels are located between 10 and 25 feet downgradient of the area where the USTs were located.

Soil laboratory analytical results from borings advanced in the vicinity of the current truck shop area indicate that oil and grease (EPA Method 9071) were detected above the North Carolina action limit of 250 ppm in boring B-85 located near the waste oil storage area. The results indicate that concentrations of volatile organic aromatics (VOA) (EPA Method 8021) are located in the soils between 5 and 20 feet.

The contaminants detected in the surface soil samples collected from the ditch along the southern property boundary, east of the former service station, are most likely the result of run-off from the truck shop or former service station.

To further assess the extent of soil contamination in the vicinity of the former asphalt plant, Geophex, Limited (Geophex) was contracted to conduct a ground-penetrating radar (GPR)

survey in the area. The purpose of the study was to identify existing concrete structures that were part of the asphalt plant and to locate any buried deposits of tar or asphalt. The GPR report prepared by Geophex identified four anomalous regions within the survey area (Appendix A - Figure 18). In addition, Geophex identified the locations of various metal objects based on the GPR data. The anomalous area identified as Area I by Geophex is believed to be the water supply line that crosses the survey area and terminates at the quarry pit. The water line was part of the municipal supply system, but was abandoned to allow the quarry to expand. Areas II, III, and IV could not be immediately identified.

On January 11 and 12, 1995, Front Royal personnel were onsite to investigate the anomalous areas detected during the GPR survey. A backhoe was used to cut trenches in the areas identified by Geophex as Areas II, III, and IV (Appendix A - Figure 18). Where possible, the trenches were installed to a depth of 10 feet. The anomalous readings from Area II were determined to be concrete foundations that were part of the former asphalt plant. The soils in the area are fill materials and contain miscellaneous metal pieces, asphalt pieces, and decaying wood material. Various soil samples were collected during the trenching activities and were field screened for organic vapors using an OVA. OVA readings in the area ranged from 6 ppm to 1000+ ppm. Due to the decaying organic matter located in the fill material it is possible that the elevated OVA readings are the result of biodegradation of wood materials and not hydrocarbon vapors.

No subgrade foundations or contaminant deposits were detected in Areas III and IV, however historical site maps indicate that a sedimentation pond was located in the vicinity of these areas during the 1960's. By 1974 use of the pond had been discontinued and the pond had been closed. The soils in these areas are believed to be native material and clean fill material that was deposited during the pond closure. It is probable that the anomalous readings were the result of clay lenses from the former sedimentation pond.

To further assess soil contamination in the vicinity of the former asphalt plant, and to facilitate any future remedial activities, Teer employees, under the supervision of Front Royal personnel, removed the concrete foundation detected in Area I. The soils removed during excavation activities were temporarily stockpiled onsite on plastic. In July 1995, the stockpiled soil was sampled by Front Royal personnel. Two samples were collected from an estimated rectangular stockpile with pointed crest. Each sample was made up of 6 composite samples collected at depths between 2 and 4 feet. The samples were collected with a decontaminated hand auger. The primary samples were placed in clean glass jars, capped, and stored in a chilled environment. Due to the outside conditions, the primary samples were transported to an offsite area to be composited in a cool environment out of the direct sun. The primary samples were composited and immediately placed in clean glass jars, capped, and stored in a chilled environment and transported under chain of custody to a certified laboratory.

The composite sample was analyzed for high and low boiling point fuels (EPA Methods 5030/3550), oil and grease (EPA Method 9071), volatiles (EPA Method 8240), semi-volatiles (EPA Method 8270), total metals, and toxicity characteristic leaching procedure (TCLP) for organics and metals (EPA Method 1311). The laboratory analytical data from Composite A indicate that TPH as diesel was detected at 149 milligrams per kilogram (mg/kg) and oil and grease were detected at 1,437 mk/kg (Appendix B). In Composite B, TPH as diesel was detected at 1,040 mg/kg and oil an grease at 618 mg/kg. TCLP metals were not detected above the EPA established maximum concentrations. All volatiles and semi-volatiles were below method detection limits.

The most recent ground water elevation data collected by Front Royal indicate that there are two aquifers at the site (Table 2). Geologic cross sections prepared by Front Royal personnel show the surface of the shallow aquifer at ranging between 5 and 10 feet, and the deep aquifer at a depth of approximately 20 to 25 feet (Figure 4 through 4D). The shallow aquifer occurs as a perched zone in fill and unconsolidate sediments. The deeper aquifer occurs in indurated triassic sediments. A potentiometric map of the shallow aquifer based on the April 1995 water level data indicates that ground water flow in the shallow aquifer is to the east (Figure 5). A potentiometric map of the deep aquifer indicates that ground water flow in the deep aquifer is toward the north/northwest.

A summary of the most recent ground water analytical data indicates that the highest levels of petroleum contaminants are located in the vicinity of the service station that was located at the southern perimeter of the property (Table 3). Benzene, ethylbenzene, and naphthalene were detected at levels above the 2L Standards in the deep aquifer in the vicinity of the former service station. A summary of historical ground water analytical data indicates that BTEX contaminants have been detected at varying concentrations in the monitor wells installed downgradient of the service station (Table 4).

Elevated levels of chlorinated solvents have been detected in the area of the former asphalt plant (Table 3). Levels of chloroform, 1,1-dichloroethane, trichloroethene, 1,1,1-trichloroethane, and cis-1,2-dichloroethylene have been detected above 2L Standards in the shallow aquifer monitor wells MW-17, MW-18, MW-25, and MW-26. Deep aquifer monitor wells, MW-13 and MW-20D indicate low levels of chlorinated solvents.

The soil laboratory analytical data indicate that isolated areas of contaminants have been detected across the site. These isolated areas could be the result of an accidental release from one of the construction vehicles or from contaminants that were accidentally carried onto the site in the fill material that is spread over the site.

1.4 Previous Reports

In October 1993, a CSA report was prepared and submitted to the NCDEM by Geonetics. The CSA report detailed ground water and soil contamination at the site, and recommended the preparation of a CAP.

In December 1993, a CAP was prepared by Geonetics and submitted to the NCDEM. The CAP further detailed ground water and soil contamination at the site and recommended a remedial action plan. Geonetics proposed to use a series of submersible ground water recovery pumps to capture the plume and diffused aeration to treat the recovered ground water. In addition, Geonetics proposed to use modified in situ bioremediation with vapor extraction and conventional soil vapor extraction to remediate contaminated soils at the site.

Multiple quarterly monitoring reports detailing the ground water contamination at the site have been prepared by Front Royal. These reports have been submitted to the Raleigh Regional Office of the NCDEM.

2 Objectives

2.1 Objectives and Goals

The objective of this CAP is to restore the quality of impacted ground water to levels as close to State of North Carolina ground water standards as possible. Remediation efforts will target North Carolina Ground Water Quality Standards until mutually acceptable levels can be agreed upon by NCDEM and Teer.

Specific goals of the corrective action plan implementation are as follows:

- to reduce, prevent, and/or mitigate further migration of hydrocarbon compounds to non-impacted areas and off-site properties.
- to reduce or eliminate any risk to the public health and well-being.
- to remove and/or reduce ground water contaminants to levels established in the North Carolina Ground Water Classification Standards, or to levels that can be demonstrated as the best obtainable using economically and technically feasible remediation methods, or to any levels that may be established or accepted and mutually agreed upon by the NCDEM and Teer, under a consent order, special order, or other agreement.

Remediation efforts will continue until it can be demonstrated that further remediation is neither feasible nor practical. If contaminant concentrations reach a maintained asymptotic level, a variance from the ground water standards will be pursued with the NCDEM for site closure.

2.2 Proposed Implementation Schedule

Upon approval of the CAP and the individual NPDES discharge permit, installation of the remedial system will be completed within 180 days. This schedule allows 5 weeks for equipment delivery and power connections. The schedule may be altered if shipping delays or other unforeseen delays occur.

3 Exposure Assessment

3.1 Characteristics of Contaminants

Gasoline is a complex mixture of petroleum hydrocarbon compounds and additives. Aliphatic hydrocarbons, cycloalkanes, alkenes, aromatic hydrocarbons, and polynuclear hydrocarbons are the gasoline constituents most soluble in ground water. The BTEX constituents present in gasoline are relatively insoluble in ground water and have high vapor pressures (Table 5). Because these contaminants prefer air as a carrier they can be easily removed from ground water through air stripping or air sparging technologies.

Diesel fuel is also a hydrocarbon mixture, however, some diesel constituents have lower vapor pressures and boiling points than gasoline constituents. Despite the comparatively low vapor pressures, the vapor pressures of diesel constituents are within the range that allow the contaminants to be effectively removed from ground water through sparging technologies.

The contaminants detected in the vicinity of the former asphalt plant are primarily chlorinated organic solvents. In general, chlorinated solvents are more soluble in ground water than petroleum hydrocarbons, however, their solubility is low enough to allow the contaminants to be removed through air sparging or stripping technologies (Table 5).

3.2 Exposure Pathways

Inhalation, ingestion, and dermal exposure are the exposure pathways from the contaminants found at the site to humans. However, the actual threat to humans is minimal due to the fact that the contaminants are confined to the subsurface. In addition, the asphalt plant and the USTs that were located on site have been removed, thereby removing the possibility of continued contamination.

The primary factors affecting the fate and transport of gasoline in the subsurface are the physical and chemical properties of the gasoline constituents and the geologic and hydrogeologic conditions at the site. Because benzene and methyl tertiary butyl ether (MTBE) are more soluble in ground water than other contaminants, they tend to migrate at a faster rate. Therefore, benzene and MTBE concentrations are often indicative of the leading edges of a plume consisting of gasoline constituents in ground water.

Some physical and chemical properties of the gasoline constituents effecting fate and transport in the subsurface include the solubility and density of the constituent, biodegradation rate, vapor pressure, and the affinity the constituent has towards soil particles and organic carbon in the soil. The rate of movement of the constituent can be slowed by the adsorption of the compound onto soil particles and organic carbon. Retardation of a compound can be measured using partition coefficients such as the octanol/water partition coefficient and the organic carbon partition coefficient.

Physical factors effecting the rate of movement of the constituents include the geology and hydrogeology of the site. Since gasoline releases usually occur above the water table in the unsaturated zone the initial movement of the gasoline is downward due to the effects of gravity. However, because of residual saturation, some of the gasoline or constituents will remain behind trapped in the pores of the soil or rock. In addition, changes in lithology encountered can alter the path and the rate of migration of the constituents in the saturated and unsaturated zones.

If the gasoline or its constituents come in contact with the water table the direction of movement of the constituents changes from vertical to horizontal along with the water table gradient. Factors such as advection and dispersion can then have an effect on the rate and path the constituents will migrate. Due to the solubility of some of the constituents in ground water, the processes of advection and dispersion may contribute to the contamination of the aquifer at depth.

Since the partition coefficients, biodegradation rates, and dispersion coefficients have not been determined for this site, a conservative estimate of the rate of movement of the more soluble constituents, such as benzene and MTBE, can be assumed as the same as the velocity of the ground water. In the CSA Report, the average seepage velocity was estimated to be 0.37 feet per day. This is a conservative estimate because these constituents will actually migrate at a slower rate due to the effects of dispersion, adsorption, and biodegradation. Therefore, the rate and direction of movement of the more mobile constituents can be conservatively estimated from ground water velocity and flow direction.

3.3 Receptors

The site covers approximately 340 acres in northern Durham just outside of the city limits. The contaminated areas are located at the south side of the facility near the areas where the gas station and asphalt plant were located. The areas north, east, and west of the site are predominately residential. The Eno River serves as the northern property boundary. City sewer and water maps show that these residential areas are served by city water and sanitary sewer lines.

The area south of the site along Denfield Street and Communication Drive is both commercial and residential. Site investigations conducted by Front Royal and Geonetics personnel revealed that the residences and businesses in the area are served by water supply wells. Through a records search at the Durham County Health Department and through site investigations, eleven water supply wells were located within 1,500 feet of the site along Denfield Street and Communications Drive (Table 6). None of the off site water supply wells are located within the contaminant plume. The quarterly monitoring data indicate that the petroleum contaminant plume is migrating towards the north and east, away from the southern property boundary of the Nello Teer quarry.

In addition to the eleven off site water supply wells, there are three water supply wells located on site. The water from these wells is not used as a potable water source. Bottled drinking water is supplied to all employees at the site. The water from the onsite wells is used for truck washing and sanitary purposes. On-site supply well W-1, which was located within the contaminant plume, has been abandoned in accordance with the North Carolina well construction standards.

Municipal sanitary sewer and water supply maps obtained from the city of Durham Engineering Office indicate that no sanitary sewer lines are located in the vicinity of the site. However, two water supply lines, one 24-inch diameter and one 42-inch diameter, cross the site starting at the southern property boundary (Figure 7). The 24-inch diameter water supply line was cut to allow expansion of the quarry and is no longer in use, however, a portion of the line is still buried below the site. The 42-inch diameter water supply line runs along the east side of the quarry pit.

The risk of contaminant infiltration in the pipes is minimal. However, the 42-inch water supply line is located in the area of the former gas station and could potentially serve as a conduit to transport contaminants to non-impacted areas.

In the future the site may be used as a raw water holding pond and a natural habitat area for the city of Durham. Front Royal contacted the North Carolina Natural Heritage Program (NCNHP) to determine if any rare species are located at the site. The information provided by the NCNHP indicates that a rare species inventory has not been conducted for the site, and therefore it can not be stated that rare species do not occur at the site (Appendix C). The information provided by the NCNHP did indicate that the Eno River Blue Wild Indigo Slopes Natural Heritage Area is located 0.15 miles east of the site. In addition, adjacent to the Eno River natural area is the Penny's Bend natural area. Rare species are known to exist in both areas (Appendix C). Because of the proximity of the site to the known natural areas, it is possible that rare species may also occur at the site. However, the existence of rare species at the site can only be confirmed through a systematic inventory conducted by qualified state personnel. The corrective action strategy proposed herein will have no forseeable effects on any rare species which might exist at the site.

3.4 Post Remedial Contamination Effects

The goals of the proposed remedial action presented in this CAP are to reduce, prevent, and/or mitigate migration of the contaminant plume, and to reduce soil and ground water contaminants to a level agreed upon by the NCDEM and Teer. Any potential for contamination will be reduced over time with remediation. Residual contaminants found after remediation efforts have ceased will continue to biodegrade over time, thereby reducing the potential risk to ground water and nearby surface waters.

4 Proposed Corrective Action Plan

In the December 1993 CAP, Geonetics proposed to install a pump and treat remediation system using four vacuum enhanced ground water recovery wells, a diffused aeration system, and a liquid phase carbon system. In addition, Geonetics proposed to install a soil vacuum extraction (SVE) system in the vicinity of the septic tank drain field, and a combined in situ bioremediation/SVE system in the vicinity of the former asphalt plant.

After reviewing the remedial system proposed by Geonetics, as well as the current site conditions, Front Royal proposes to install a pump and treat remedial system. Ground water will be recovered through seven 6-inch diameter ground water recovery wells. A tray-type stripping tower (ST-1) will be used to treat the contaminated ground water. An electric air blower, B-1 will supply air to the stripping tower. Treated effluent will collect in the stripping tower sump and will be discharged through a transfer pump to a liquid phase granular activated carbon system. The treated ground water will be discharged under an individual National Pollutant Discharge Elimination System (NPDES) permit. Four of the ground water recovery wells have been installed in the vicinity of the former service station. Recovery wells RW-2, RW-3 and RW-4 were installed by Geonetics in December 1993. The recovery wells installed by Geonetics are screened across both the shallow and deep water tables. Recovery wells RW-1, RW-5, RW-6, and RW-7 have been installed by Front Royal. Well logs are included in Appendix D.

The deep recovery zone created by recovery wells RW-1, RW-2, RW-3 and RW-4 was determined based on runs of Flowpath version 5.0, a finite difference ground water flow model developed by Waterloo Hydrogeologic Software (Appendix E). The model uses the modified iterative, alternating direction, implicit method to determine the recovery flowpaths for ground water extraction wells. The method is an iterative technique that takes into account non-linear problems such as unconfined aquifers. An average hydraulic conductivity of 0.38 feet per day, a porosity of 0.05 and an assumed flow rate of 21,600 gallons per day total were assumed for the purposes of the model. Based on the modeling results, the recovery wells will produce a capture zone that will recover the areas of elevated contaminant levels (Figure 8).

The locations of shallow recovery wells RW-5, RW-6 and RW-7 were selected based on multiple runs of Flowpath version 5.0 (Appendix F). An average hydraulic conductivity of 5.0 feet per day, a porosity of 0.20 and a total assumed flow rate of 3,600 gallons per day were assumed for the purposes of the model. The recovery wells at the proposed locations, as predicted by the model, will produce a capture zone that will recover the areas of elevated contaminant levels in the vicinity of the former asphalt plant (Figure 9). The modeled capture zones are estimates and may vary from the actual recovery zones due to the heterogeneous and anisotropic nature of the aquifer material.

To remediate contaminated soils, Front Royal proposes to install two SVE systems. The first system will be in the vicinity of the former service station, the second will be in the area of the current truck shop (Figure 10). TPH as diesel and gasoline, as well as oil and grease have been detected in the soils in these areas. The SVE systems will create air movement through the soils which will volatilize the contaminants adhering to the soil particles. The contaminants will then be removed with the air through vacuum extraction wells installed approximately four feet above the seasonal high water table (Figure 11). A header pipe will connect the vacuum lines with the above ground components of the SVE systems. From the vacuum wells, the header pipe for each system will connect to air/water separator tanks. From the air/water separators the header pipes will connect the corresponding explosion-proof regenerative vacuum blowers, VB-1 and VB-2.

The soil contaminants detected in the area of the former asphalt plant were primarily located in the shallow soils and were removed during the concrete slab excavations. The soils are currently stockpiled onsite. To dispose of the stockpiled soils, Front Royal proposes to land apply the soils onsite. It is estimated that there are approximately 200 cubic yards of soil to be land applied. The soil laboratory analytical data indicate that the soils were below limits established for TCLP - Metals. The primary contaminants detected in the excavated soils are TPH as diesel and oil and grease. The proposed application area covers approximately 0.5 acres along the southern rim of the quarry (Figure 12).

The remedial system will be located in the vicinity of the former service station area. This area is out of the way of vehicle traffic and daily site activities, and is located near a power

transformer to allow convenient power connections. According to Mr. Don Daniels of Duke Power of Durham, a single phase 120/240 volt power supply is available at the site, however, three phase power may be obtained if needed for more efficient remedial system operation.

5 Remedial System Design

5.1 Conceptual Design

Recovery wells RW-1, RW-2, RW-3, and RW-4 have been installed in the vicinity of the former service station (Figure 10). Recovery wells RW-5, RW-6, and RW-7 have been installed in the vicinity of the former asphalt plant. All remedial system components will be equipped with the necessary valves and appurtenances as shown in the piping and instrumentation diagram (Figure 13 and 14).

5.2 Basis of Design

5.2.1 Recovery Pumps

Due to the high expected flow rates and pump depths, submersible electric pumps will be used to recover the contaminated ground water. The pumps are sized to accommodate the expected yield from each of the recovery wells, and will be constructed of stainless steel to provide durability and corrosion resistance.

5.2.2 Oil/Water Separator

The oil/water separator, OW-1, is sized to accommodate a maximum flow rate of 75 gallons per minute. This is adequate to handle the expected system flow rate of 53 gallons per minute. The oil water separator will be equipped with a sludge chamber to collect any solids that settle out of the process stream. The sludge chamber will be equipped with a valve to allow removal of accumulated solids.

5.2.3 Free Product Storage Drum

A 55-gallon holding drum, T-1, will be installed to receive any free product removed from the process stream by the oil/water separator. The drum will be insatlled on a prefabricated containment pallet to provide secondary containment in the event of an accidental release from the holding drum. In addition, the drum will be equipped with a 2-inch diameter port to allow product removal through the top of the drum.

5.2.4 Surge Tank

Due to possible fluctuations in influent flow rates from the ground water recovery wells, a 500 gallon surge tank, T-2, will be installed upstream of the oil/water separator and tray type stripping tower. The tank will be a centrifugally cast, flat bottom, open top fiberglass tank with UV inhibitor. The tank will be fabricated with a lip flange and will be equipped with flanged connections. A level switch located inside the tank will shut down the system in the event of high or low level. The level switch will also control the tranfer pump to the stripping tower.

5.2.5 Transfer Pumps

Two transfer pumps, P-8 and P-9, will be installed between the equilization tank, T-2, and the tray type stipping tower, ST-1. The pumps will be capable of pumping 60 gallons per minute at 35 feet total dynamic head. The dual pumps will be installed in parallel with A/B pump controls to allow for pump maintenance and pump change out without system shutdown.

Two transfer pumps, P-10 and P-11, will be installed to transfer treated ground water from teh stripping tower sump to the liquid phase carbon. The pumps will be installed with A/B pump controls to allow the system to run with either pump. The pumps will be capable of pumping 60 gallons per minute at 35 feet total dynamic head.

5.2.6 Tray Type Stripping Tower

The tray type stripping tower will be capable of handling an influent flow rate of up to 75 gallons per minute. The air supply blower supplied with the stripping tower system will be sized to maintain a minimum air/water ratio of 150:1 at in influent flow rate of 75 gpm.

The stripping tower will be equipped with a level switch that will activate the transfer pump when the water level in the sump reaches a preset level. When the water level drops to the preset minimum level, the level switch will turn the transfer pumps off. The level switch will be equipped with a high-high level setting that will shut the remedial system down if the water level in the sump continues to rise beyond the setting that should turn the transfer pump on.

5.2.7 Granular Activated Carbon

Two granular activated carbon units, with a minimum capacity of 500 lbs of carbon, will be installed as shown on the drawings. The carbon will be selected based on its adsorption capacity of the organic contaminants present in the process stream. The carbon vessels will be installed in series to ensure permit compliance. In addition, the carbon vessels will be capable of accumulating the high pressure flows from the transfer pumps.

5.2.8 SVE Blowers

Two regenerative, explosion proof SVE blowers (VB-1 and VB-2) will be installed as shown on the drawings. Vacuum blower VB-1 will be capable of providing a minium air flow of 70 cubic feet of air per minute at 50 inches of water vacuum. Vacuum blower, VB-2, will be capable of providing a minimum air flow of 40 cubic feet of air per minute at 50 inches of water vacuum.

5.2.9 Unit Control Panel

The unit control panel (UCP) will be designed to incorporate all necessary switches, indicator lights, instrumentation, relays, starters, fuses, circuit breakers, etc. to completely control the installed equipment. The UCP will require only the connection of the specified operating power. The UCP will contain an adequately sized transformer to supply the required voltage to all components. The UCP will be UL listed and the enclosure will be NEMA 4 with quick release stainless steel latches.

5.3 System Control Narrative

Chemically impacted ground water will be extracted by the installed submersible electric pumps, P-1 through P-7. Pumps P-1 through P-7 will be controlled by hand-off-automatic hand switches HS-1 through HS-7. The pumps will be equipped with motor controllers to prevent excessive current draw and motor overload. The ground water will be pumped from the extraction wells, RW-1 through RW-7, to the oil/water separator, OW-1. Prior to entering OW-1, the extracted ground water flow from each recovery well will be measured and totalized by flow elements FE-1 through FE-7.

Control input to the recovery pumps will be provided by LE-1 lcotaed in T-1, LE-2 located in T-2, and LE-3 located in ST-1. LE-1 will shut-off, by switch LSH-1, pumps P-1 through P-7 when the free product level in T-1 reaches 32 inches. LE-2 will shutoff, by switch LSHH-2, pumps P-1 through P-7 when the water level in T-2 reaches 12 inches below the top of the tank. LE-3 will shutoff, by switch LSHH-3, pumps P-1 through P-7 when the water level in the stipping tower sump reaches a manufacturer preset high level. These high level shutdowns will trigger an alarm light on the front of the unit contorl panel and will require a manual reset of the system.

Transfer pumps, P-8 and P-9, will pump recovered ground water from the flow equalization tank, T-2, to the stripping tower, ST-1. The pumps will be installed in parallel and will be controlled by an A/B controller switch. The pumps will be activated by hand-off-automatic switch HS-8. Control input to HS-8 will be provided by level element LE-2 located in T-2. LE-2 shall activate, by switch LSH-2, transfer pump P-8/P-9 when the water level reaches 18

inches below the top of the tank. LE-2 shall shutoff, by switch LSL-2, pump P-8/P-9 when the water level in T-2 drops to 6 inches above the bottom of the tank.

Air supply blower B-1, will be controlled by dedicated hand-off-automatic hand switch, HS-9. HS-9 receives control input from pressure element PE-1. PE-1 will measure the pressure of the air discharge from B-1. PE-1 will be provided with a high pressure switch, PSH-1 that when triggered will shut down the air supply blowers and the recovery pumps. This shutdown will require a manual reset of the system. When triggered, PSH-1 will energize an alarm light PAH-1 on the front of the unit control panel.

Transfer pumps, P-10 and P-11, will pump treated ground water from the stripping tower sump through the granular activated carbon canisters. The pumps will be installed in parallel and will be controlled by an A/B controller switch. The pumps will be activated by hand-off-automatic switch HS-10. Control input to HS-10 will be provided by level element LE-3 located in the stipping tower sump. LE-3 will activate, by switch LSH-3, transfer pump P-10/P-11 when the water level in the stripping tower sump reaches a manufacturer preset level. LE-3 will shutoff, by switch LSL-3, pump P-10/P-11 when the water level in the sump drops below a manufacturer preset level. Prior to passing through the carbon canisters, the treated ground water flow will be measured and totalized by flow element FE-8. Treated water will be discharged under an individual NPDES permit.

Vapor extraction blowers, VB-1 and VB-2, will be activated by hand-off-automatic switches HS-11 and HS-12, respectively. HS-11 will receive control input from pressure element PE-2. PE-2 will measure the vacuum of VB-1. PE-2 will be provided with a low pressure switch, PSL-2. When energized, PSL-2 will shutdown VB-1 and will energize an alarm circuit, PAL-2, on the unit control panel. HS-11 also receives control input from level element LE-4 located in air/water separator T-3. LE-4 will shutdown, by switch LSH-4, vacuum blower VB-1 when the water level in T-3 reaches 30 inches. LSH-4 will also trigger an alarm light, LAH-4, on the front of the unit control panel. This shutdown will require a manual reset of the system.

HS-12 will receive control input from pressure element PE-3. PE-3 will measure the vacuum of VB-2, and will be provided with a low pressure switch, PSL-3. When triggered, PSL-3 will shutdown VB-2 and will energize an alarm circuit, PAL-3, on the unit control panel. HS-12 also receives control input from level element LE-5 located in air/water separator T-4. LE-5 will shutdown, by switch LSH-5, vacuum blower VB-2 when the water level in T-4 reaches 30 inches. LSH-5 will also trigger an alarm light, LAH-5, on the front of the unit control panel. This shutdown will require a manual reset of the system.

5.4 System Layout

The remedial system will be located in the vicinity of the former service station, out of the way of daily construction traffic and business activities (Figure 10). The system will be located

near an existing power transformer to allow power connections to be made to the system. The system unit control panel, stripping tower, and carbon canisters will be located inside of the existing service station building. In addition, the remedial system equipment that is to remain outdoors, such as the vacuum blowers, will be enclosed by an 8 foot high privacy fence with a locking gate. The equipment will be covered by a protective canopy to minimize equipment exposure to the elements.

5.5 Security and Safety

5.5.1 Security

All equipment that will remain outdoors will be surrounded by an 8 foot high privacy fence with a lockable gate. The doors to the service station building and the gate to the privacy fence will be equipped with locks to prevent unauthorized access.

5.5.2 System Safety Features

The remediation system is provided with multiple fail-safe features to prevent an accidental release or discharge of contaminated ground water. In the event of an equipment malfunction, power failure, or other incident which interferes with the proper functioning of the system, these features will act to ensure that adverse consequences do not occur.

The electric ground water recovery pumps will be equipped with motor controllers to prevent motor overload. The motor controllers will shut down the respective recovery pump in the event the well is pumped dry, or if the pump draws too much or too little current.

The 55-gallon holding drum T-1, that will receive free-phase gasoline from the oil/water separator will be placed on a drum pallet to provide secondary containment in the event of an accidental release. In addition, the holding drum will be equipped with a high level shutoff switch, LE-1. When triggered, the high level switch in the holding drum will shut off the remedial system. The switch will be triggered when the free product level in the holding drum reaches 32 inches.

A high level switch, LSHH-2, will be provided in the surge tank, T-2, to prevent tank overflow. When triggered, the high level switch will shut down the remedial system and will activate an alarm light on the front of the unit control panel.

A high level shutoff switch, LSHH-3, is provided to prevent overflow of the stripping tower sump. The high level switch will trigger an alarm on the front of the unit control panel and will shut off the remedial system.

The stripping tower air supply blower, B-1, is provided with a pressure relief valve, PRV-1, and a high pressure switch, PSH-1. If triggered, the high pressure switch will shut down the blower as well as shut off the ground water recovery pumps.

The air/water separators in the SVE systems, T-3 and T-4, will be equipped with intrinsically safe, level switches, LE-4 and LE-5, that will activate when the water level in eith tank reaches 30 inches. When triggered, the high level switches will shut off the respective SVE blowers and will trigger an alarm light on the front of the unit control panel. In addition, the SVE blowers will be equipped with low pressure switches, PSL-2 and PSL-3. When energized, the low pressure switches will shut down the corresponding SVE blower.

5.6 System Maintenance

Once the remediation system is installed and operating, compliance monitoring of the system effluent and ground water will be initiated. The purposes of the maintenance and monitoring program are to ensure system performance, to meet regulatory requirements, and to monitor the effectiveness and progress of the corrective action.

The maintenance program for the system will consist of weekly site visits, during which all system components will be checked for proper operation. Preventive maintenance will be performed as required. Records of all maintenance checks and flow quantities will be maintained at the site.

5.7 Compliance Monitoring

The treatment system effluent will be sampled monthly for all parameters required by the NPDES Individual Discharge Permit. In addition, the system influent will be sampled monthly in order to monitor the removal efficiency of the system. The influent and effluent samples will be analyzed for Chlorinated Solvents and Purgeable Aromatics/MTBE (EPA Method 601 and 602 Modified). The effluent flow will be monitored and recorded on a weekly basis.

5.8 Ground Water Monitoring

The ground water monitoring program will consist of quarterly sampling and analysis of selected monitor wells and water level measurements in all monitor wells. These data will confirm the efficiency of the remediation system in containing the plume and allow the progress of the cleanup to be monitored.

Quarterly sampling is proposed for wells MW-3, MW-7, MW-9, MW-11, MW-12, MW-13, MW-14 S/I, MW-15 S/I, MW-16 S/I, MW-16 S/I, MW-17, MW-18, MW-19, MW-20 S/I, MW-21, MW-22, MW-23, MW-24, MW-25 and MW-26. These wells are selected because they represent the area of the contaminant plume and will therefore serve to confirm that the

migration of contamination has been arrested. Samples will be analyzed for Chlorinated Solvents and Purgeable Aromatics/MTBE (EPA Methods 601 and 602 Modified). Water levels will be measured in the sampled monitor wells in order to confirm that the ground water recovery is influencing the hydraulic gradient at the site sufficiently to ensure the containment of the contaminant plume.

5.9 Site Limitations

Data presented in this CAP represent isolated data points. Conclusions of this CAP, including maps, calculations and models, are based on extrapolations between data points, as well as subjective hydrogeologic, soils and geologic interpretation. Therefore, the data may not be completely representative of all conditions in the study area.

Recommendations of this CAP are based on best available data. It is the premise of this effort that the information collected and analyzed is representative of a reasonable effort to understand and solve the existing problem.

6 Permits and Notification

All required local permits, a soil land application permit, and a NPDES individual discharge permit will be obtained prior to continuous operation of the ground water remediation system. In addition, the system will be registered with the NCDEM.

6.1 Soil Land Application Permit

Approximately 200 cubic yards of contaminated soils have been excavated from the former asphalt plant area. A permit to allow Teer to land apply the soils to an onsite location will be filed with the NCDEM (Appendix G). The application area covers approximately 0.5 acres along the southern edge of the quarry.

6.2 Discharge Permit

An application for an individual NPDES permit will be filed with the State of North Carolina Department of Environment, Health and Natural Resources. Under the individual NPDES permit, treated effluent will be discharged to a nearby storm drain, through a constructed wetlands area, to an unnamed tributary to the Eno River. The discharge will flow approximately 1,500 feet through 6.5 acres of constructed wetlands between the discharge point and the unnamed tributary to the Eno River. This area will serve as an additional barrier between the discharge point and the Eno River.

An evaluation of discharge options indicates that the individual NPDES permit is the best remedial option. A general NPDES permit cannot be obtained because chlorinated solvents have been detected in the ground water at the site. The site is located outside of the Durham city limits and is not connected to the municipal sanitary sewer system, therefore discharge to the Durham treatment plant is not possible. In addition, due to the nature of the soils at the site, it would not be possible to reinject the volume of ground water that is to be treated by the remedial system.

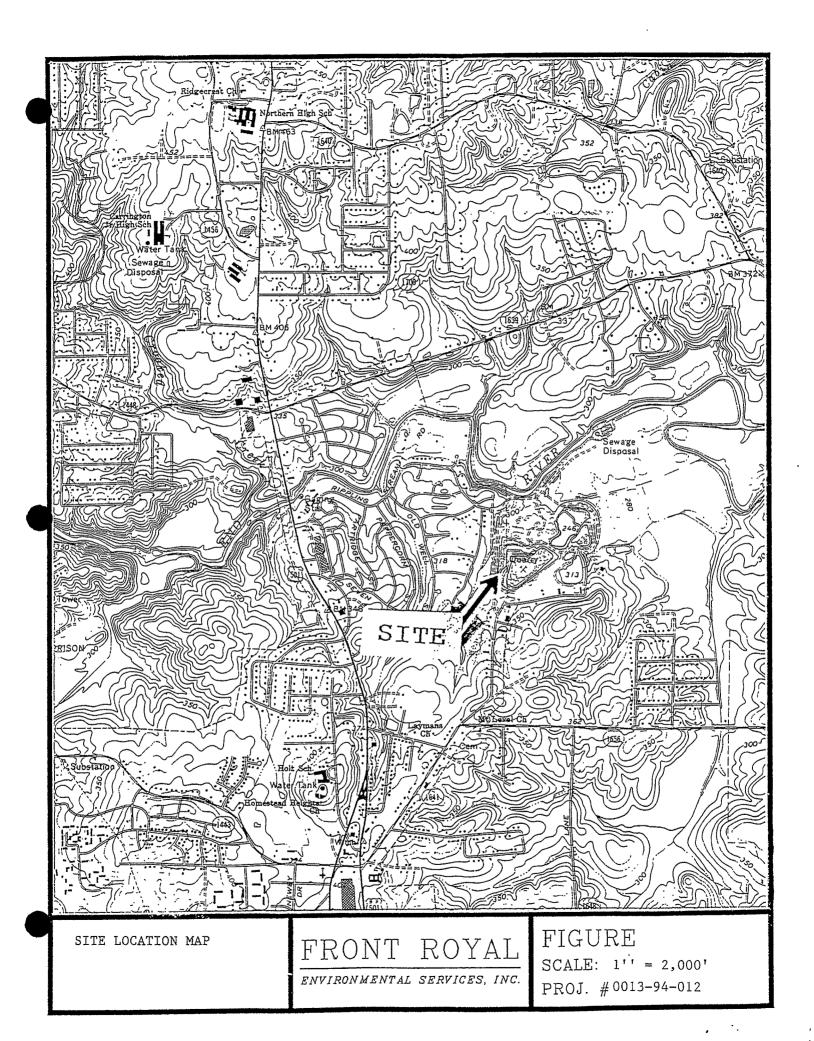
A copy of the NPDES permit application is presented in Appendix H. Copies of submittal letters and the issued permit will be provided to the Raleigh Regional Office when available.

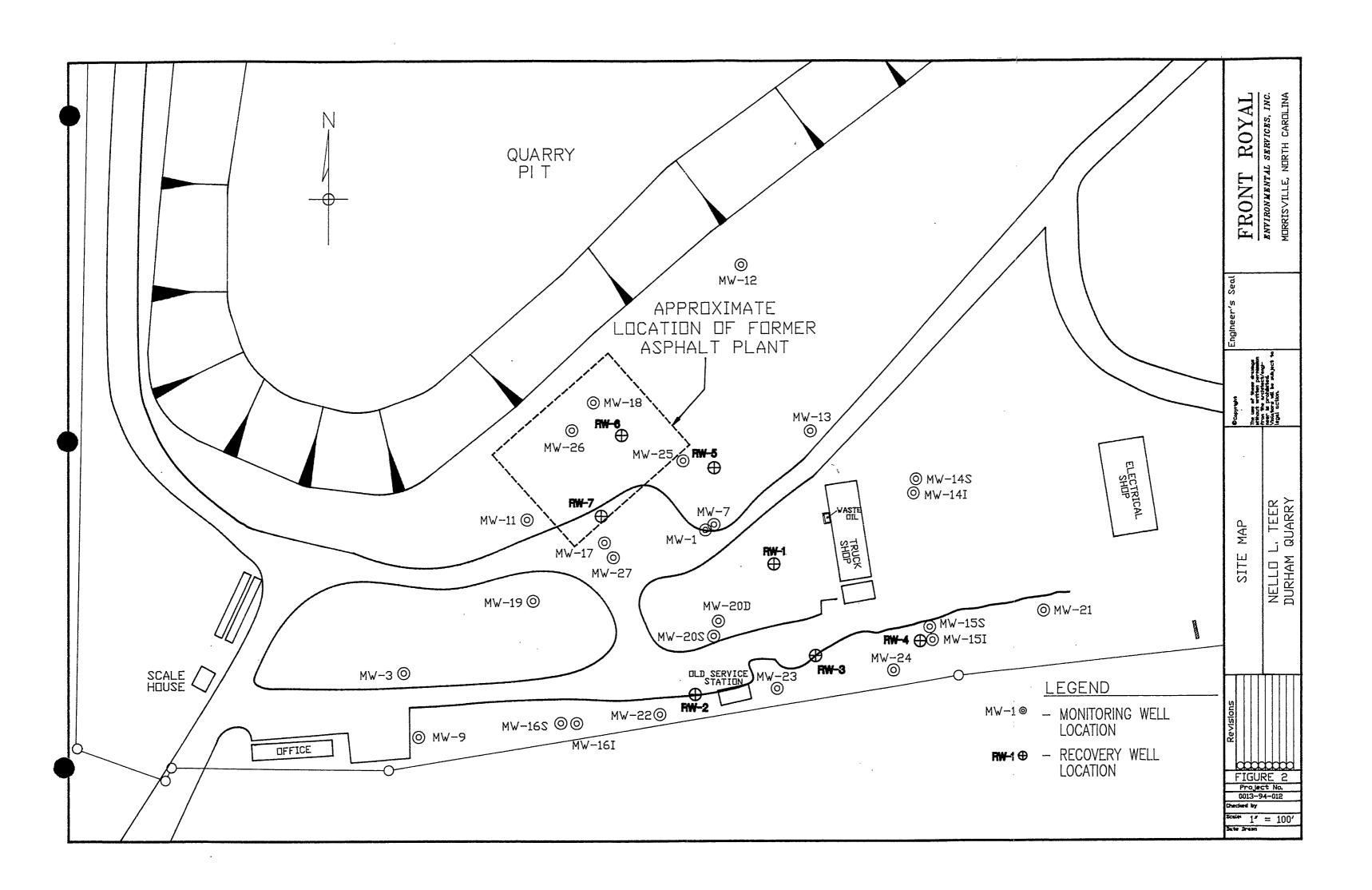
6.3 Air Quality

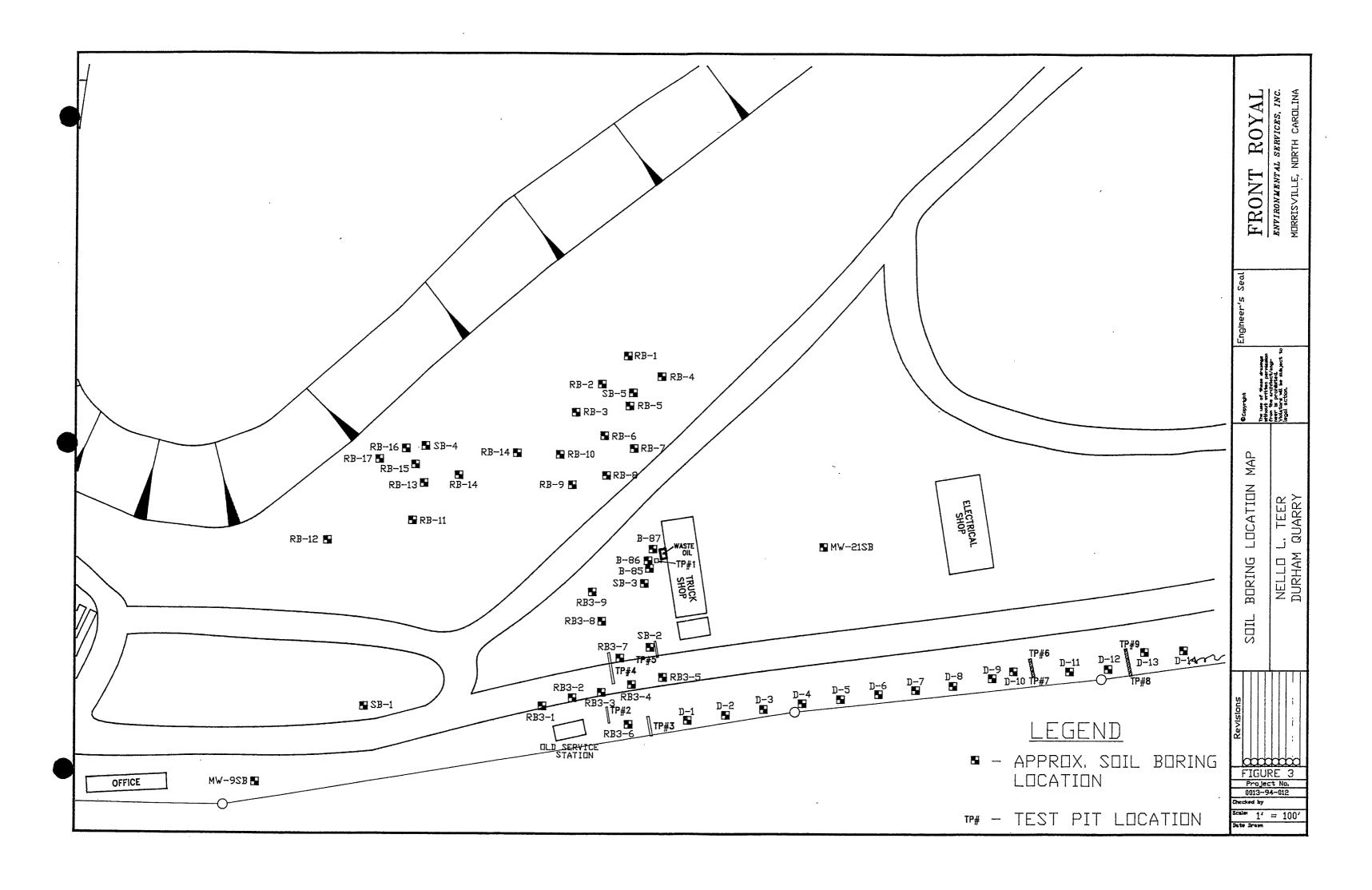
As required under 15A NCAC 2D.0202, the remedial system will be registered as an emission source with the NCDEM. Preliminary calculations bsed on assumed worst case influent contaminant concentrations indicate that the total quantity of VOCs in the air discharge from the tray type stripping tower will be 4.65 pounds per day (Appendix I). This worst case estimate is significantly below the 40 pound per day limit established by NCDEM.

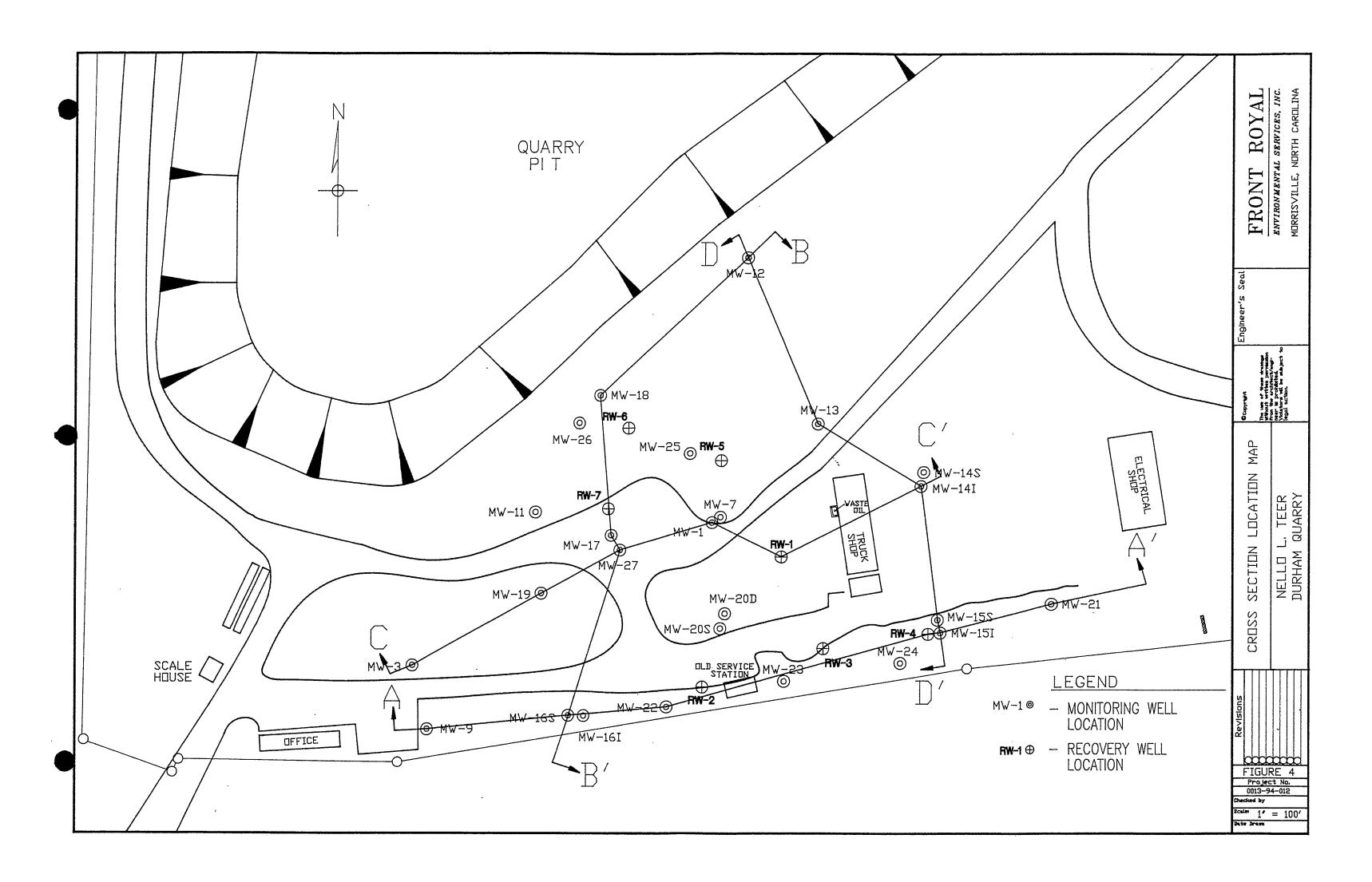
6.4 Notification Letters

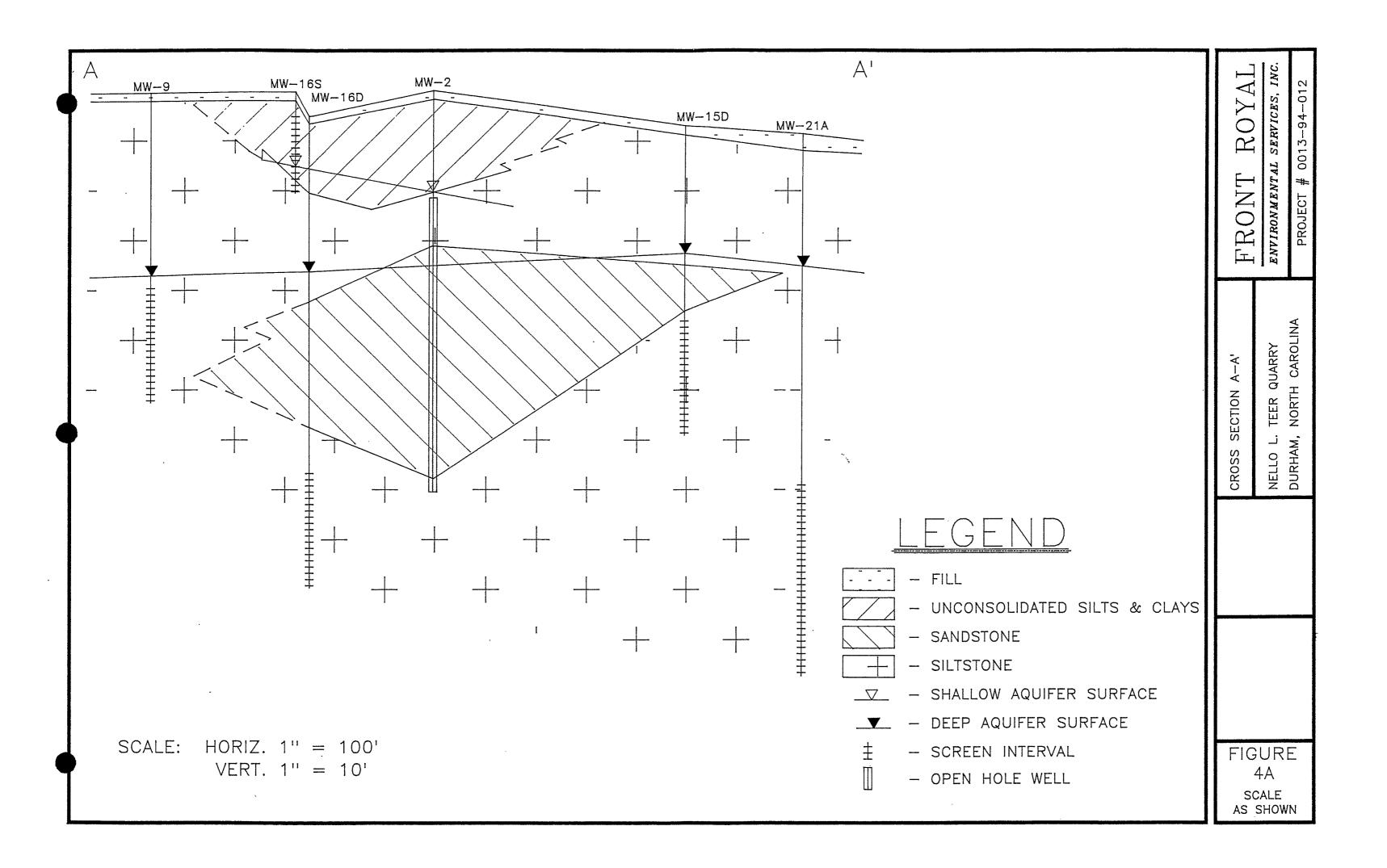
As required under Title 15A NCAC 2L .0114(a) notification letters have been sent via certified mail to the Durham County Manager and the Director of the Durham County Health Department. Copies of these notification letters are provided in Appendix J.

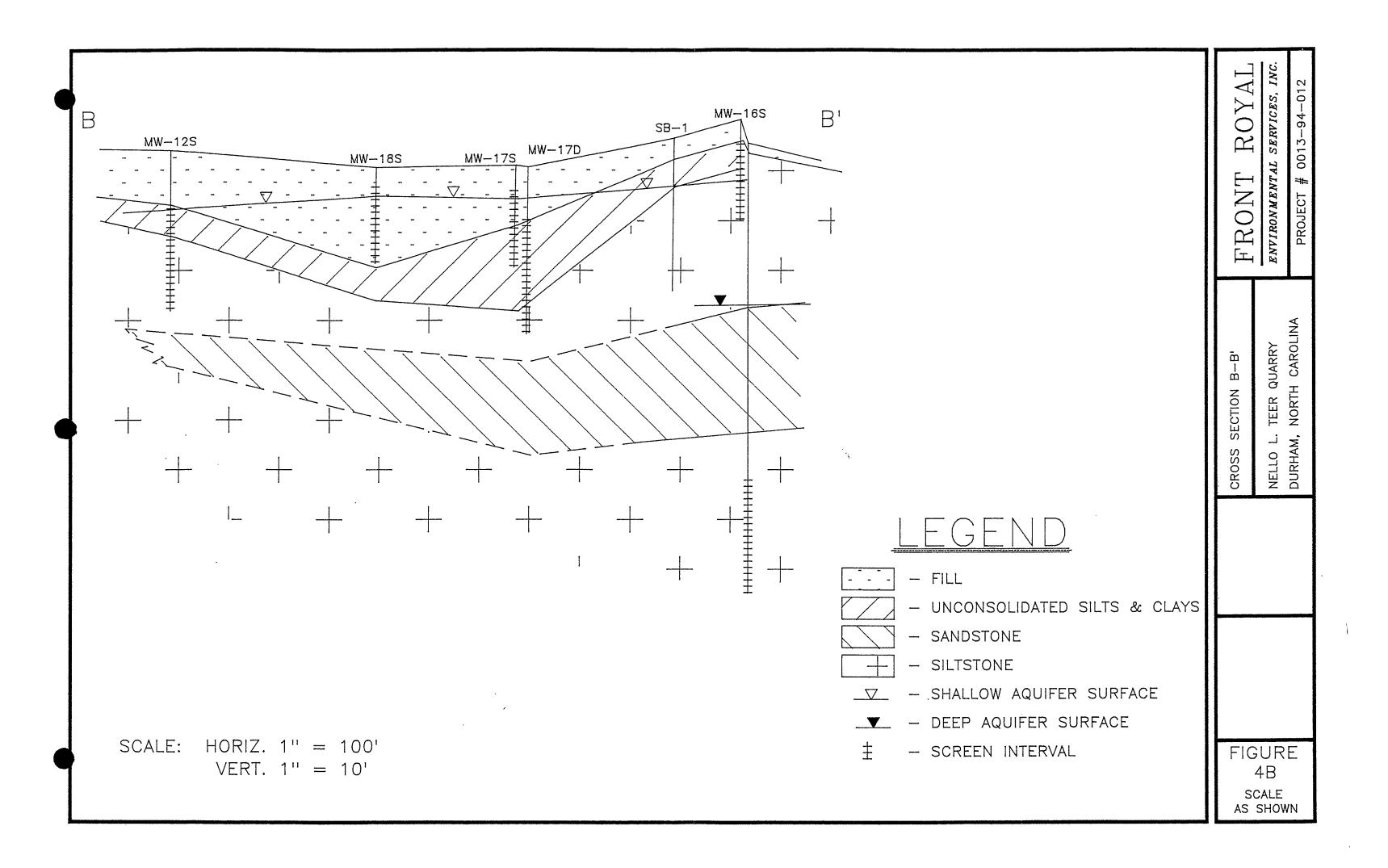


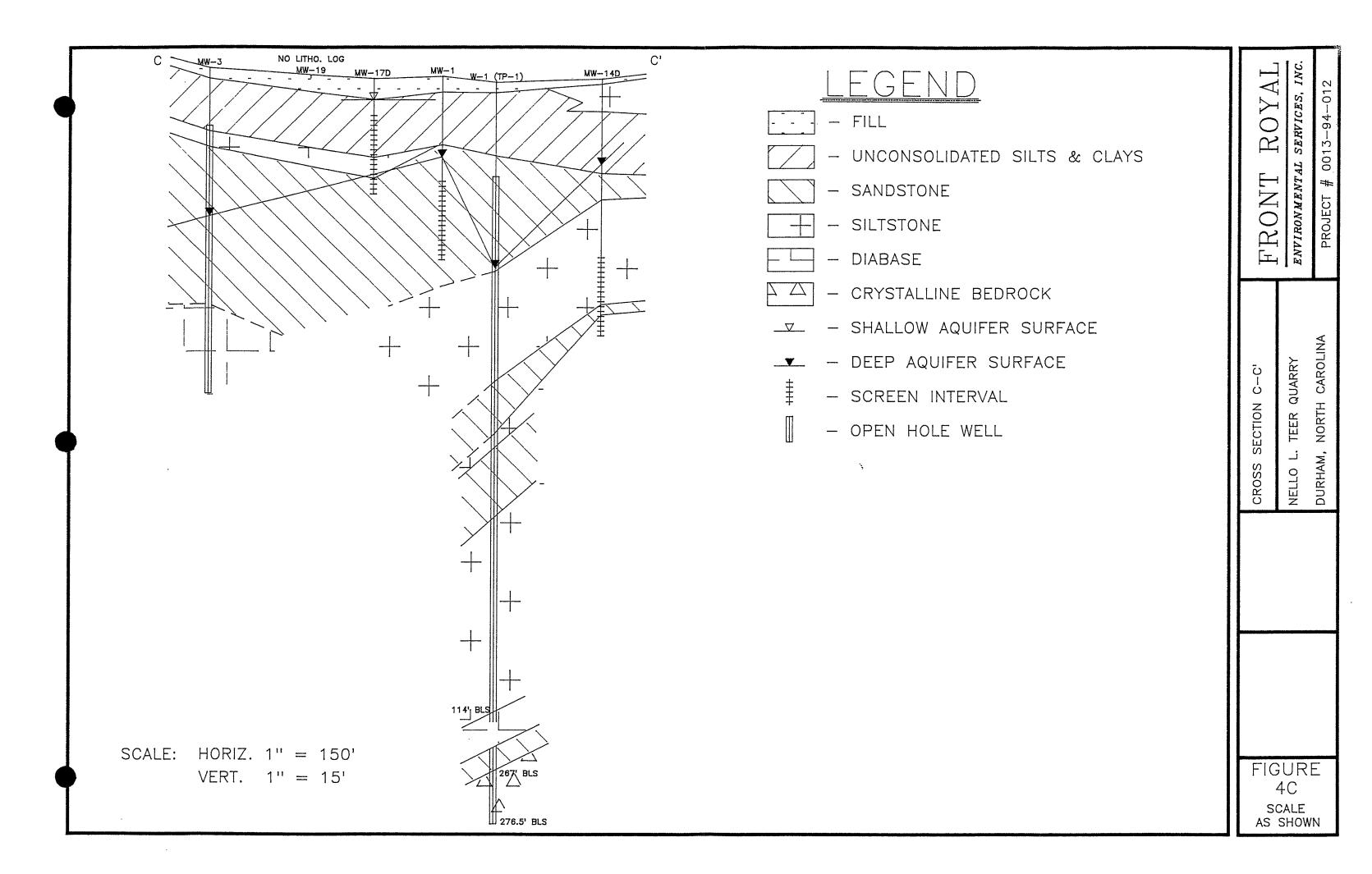


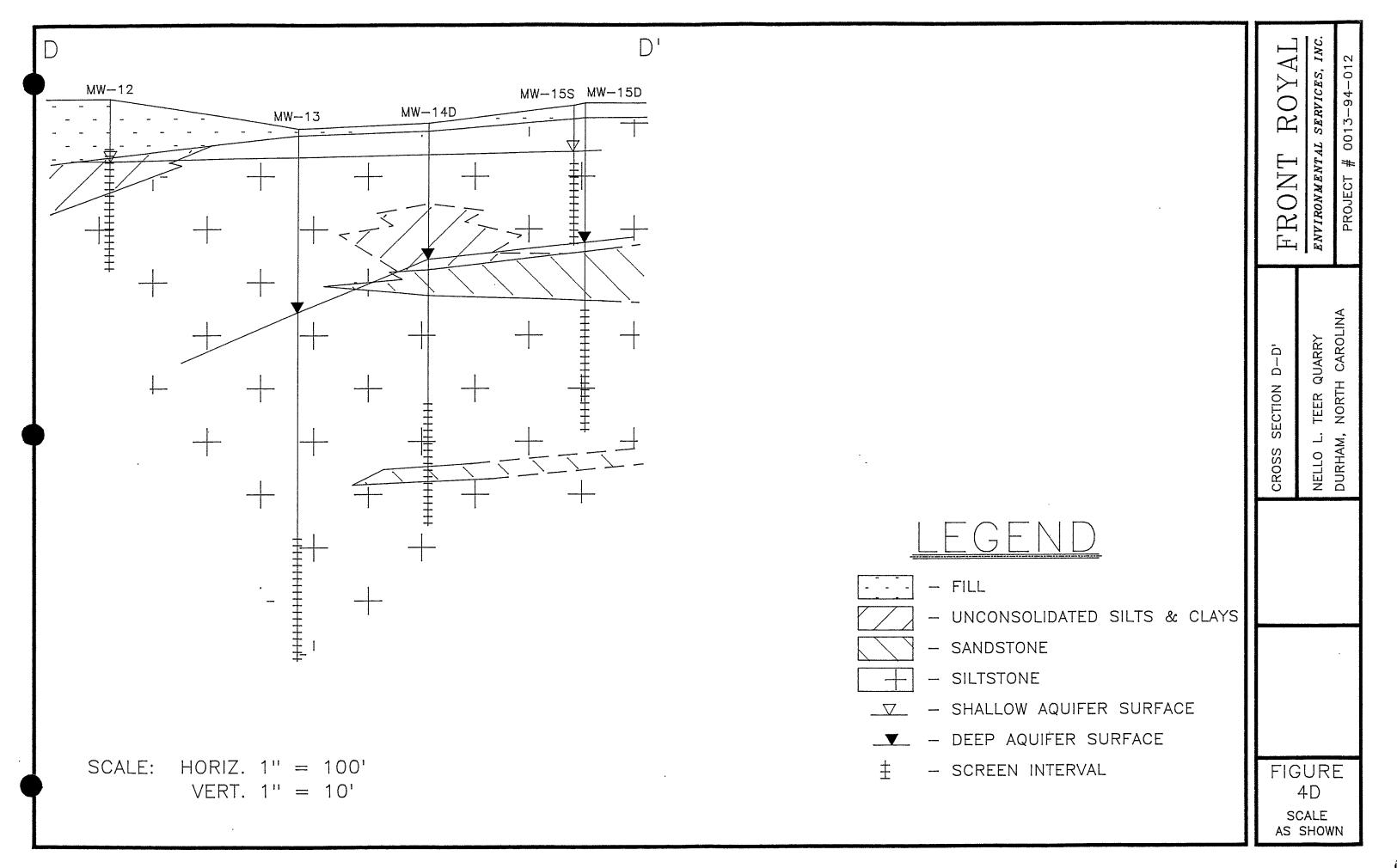


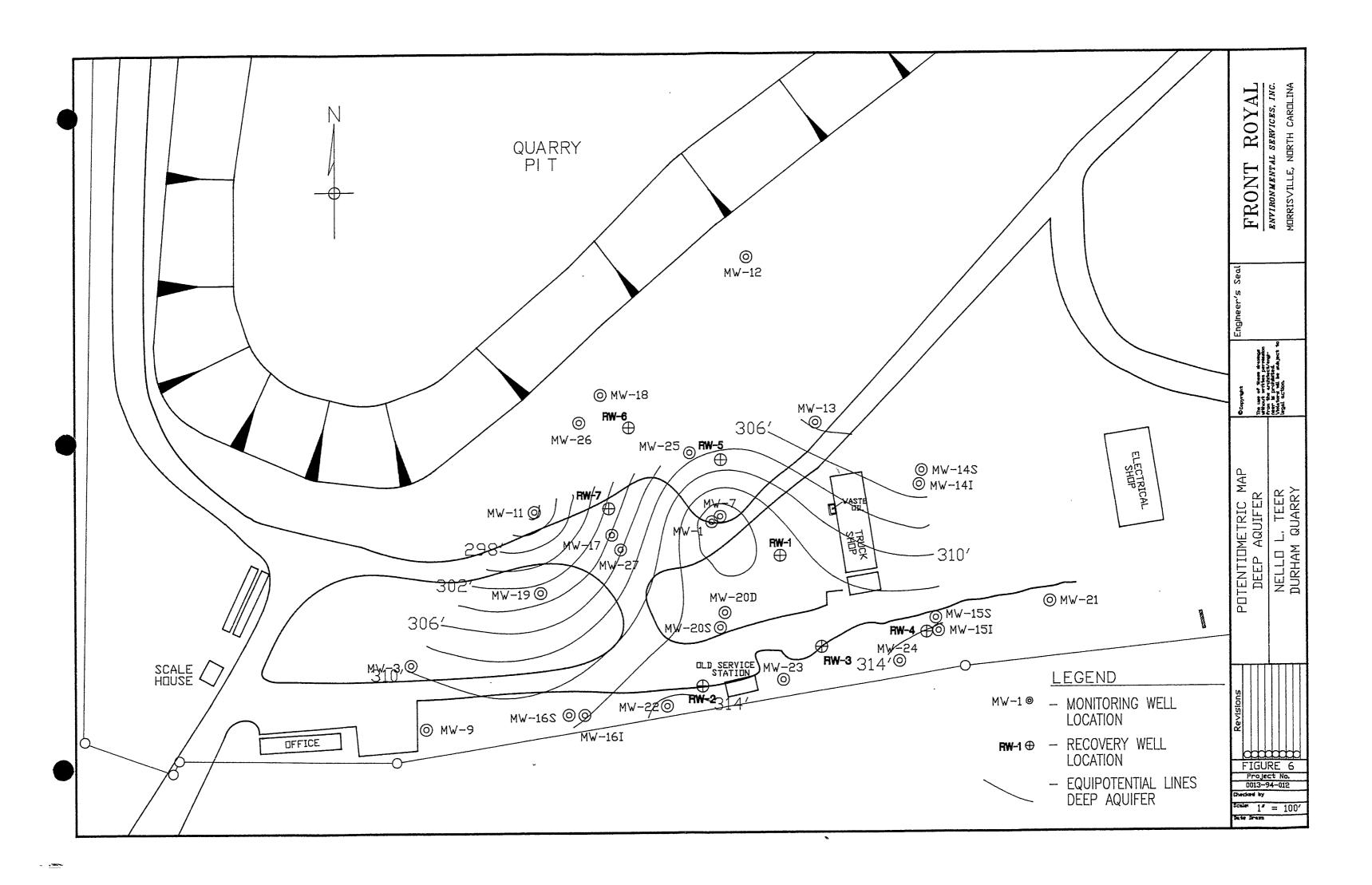


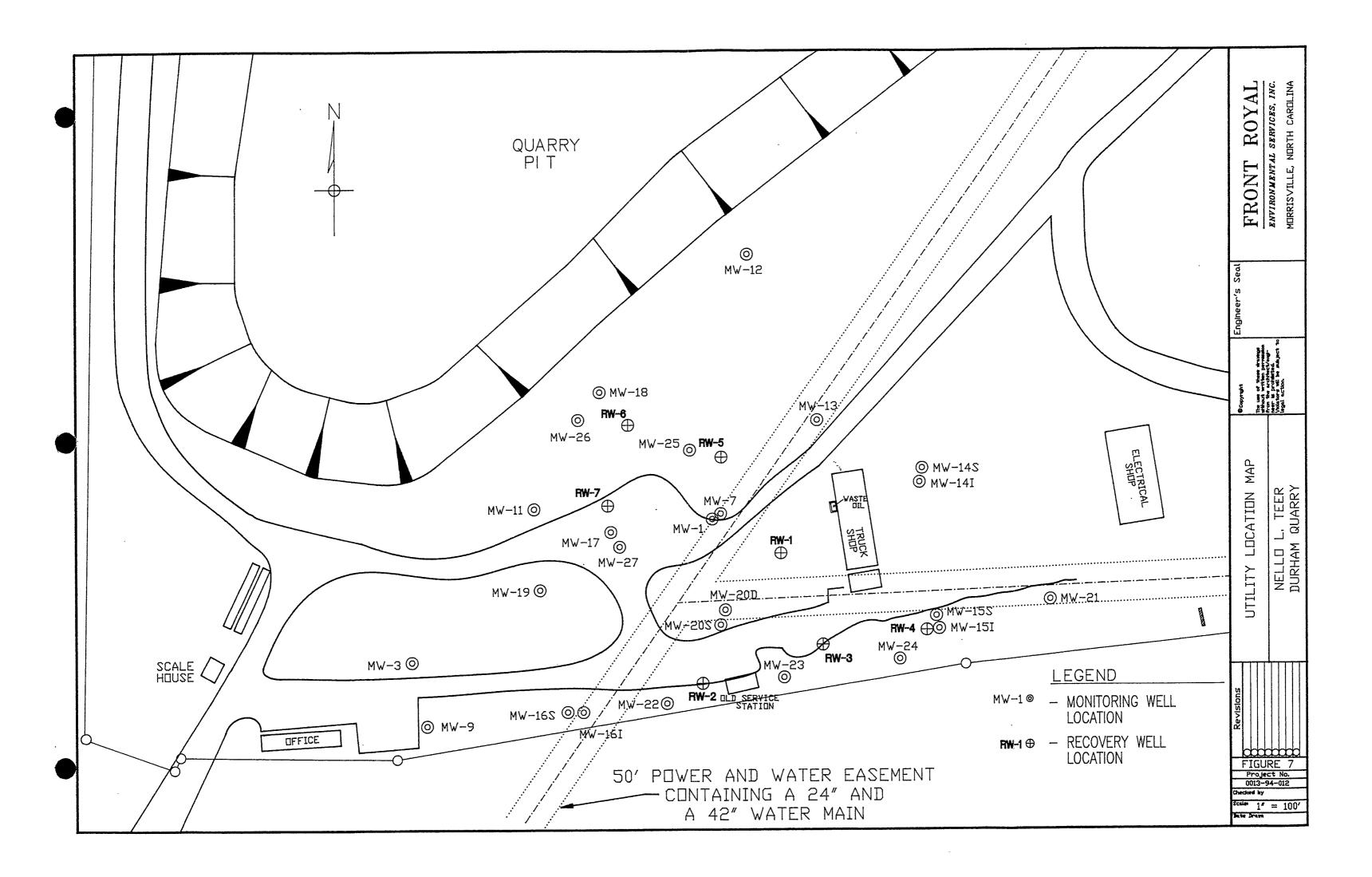


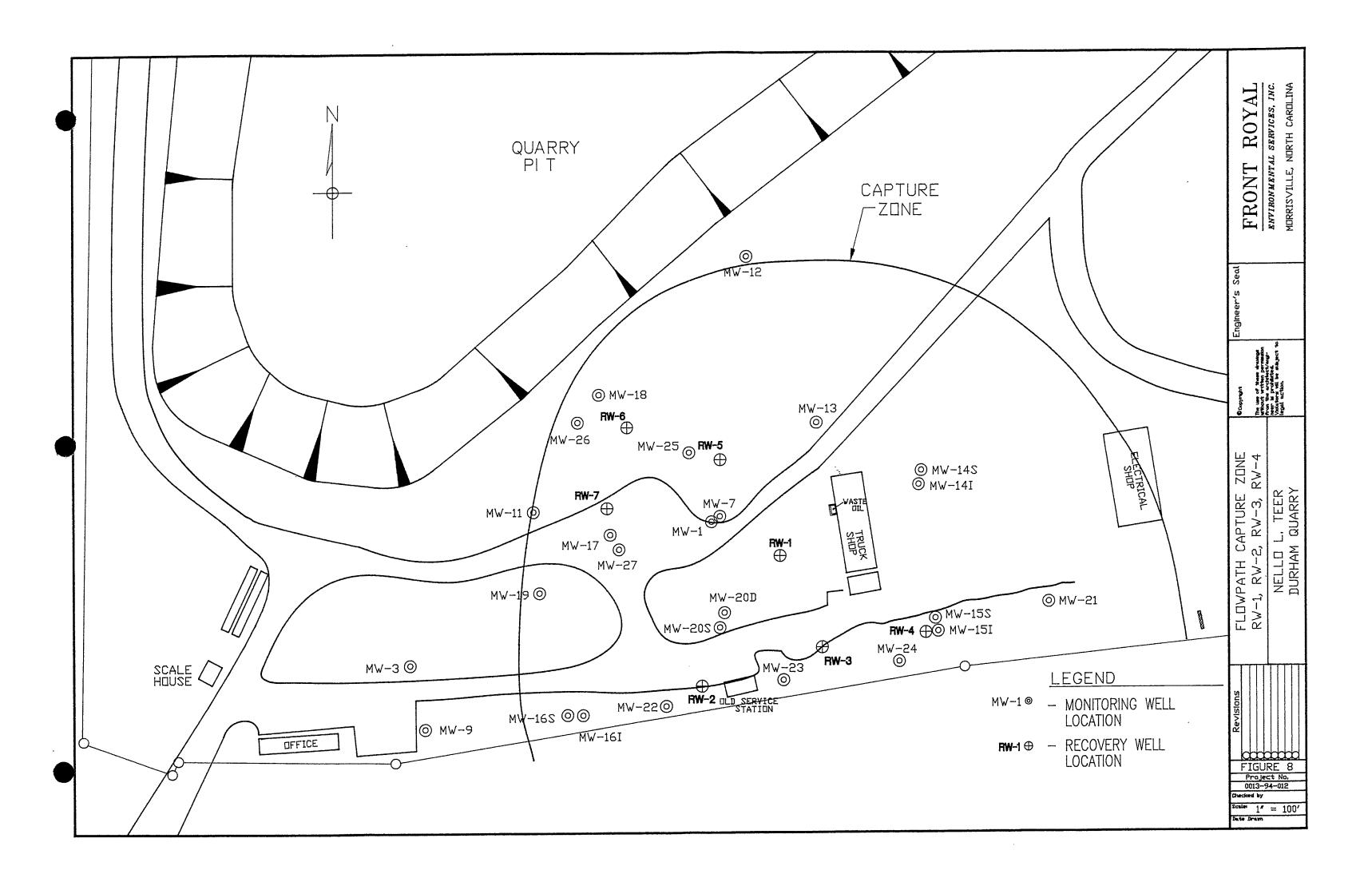


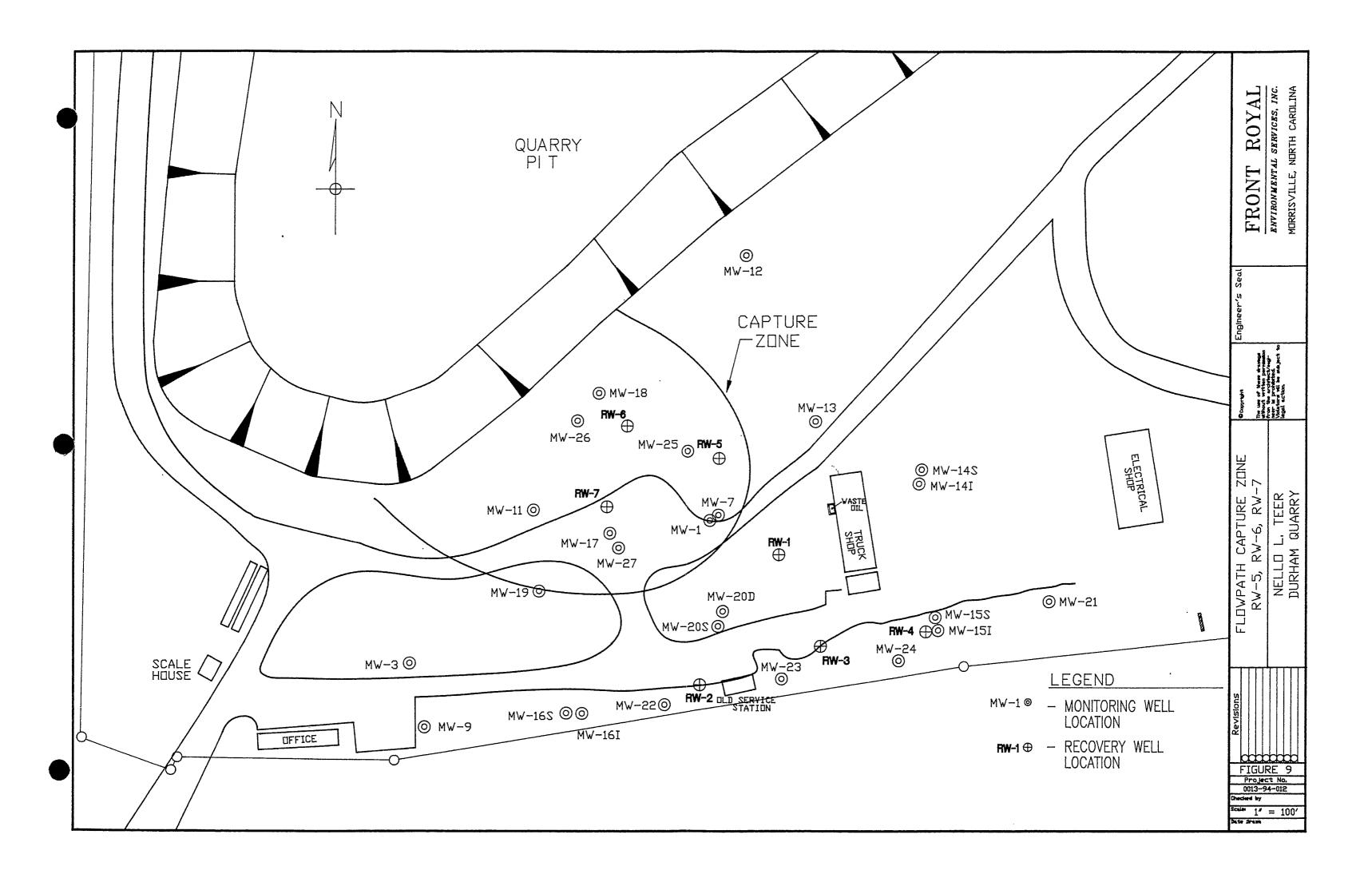


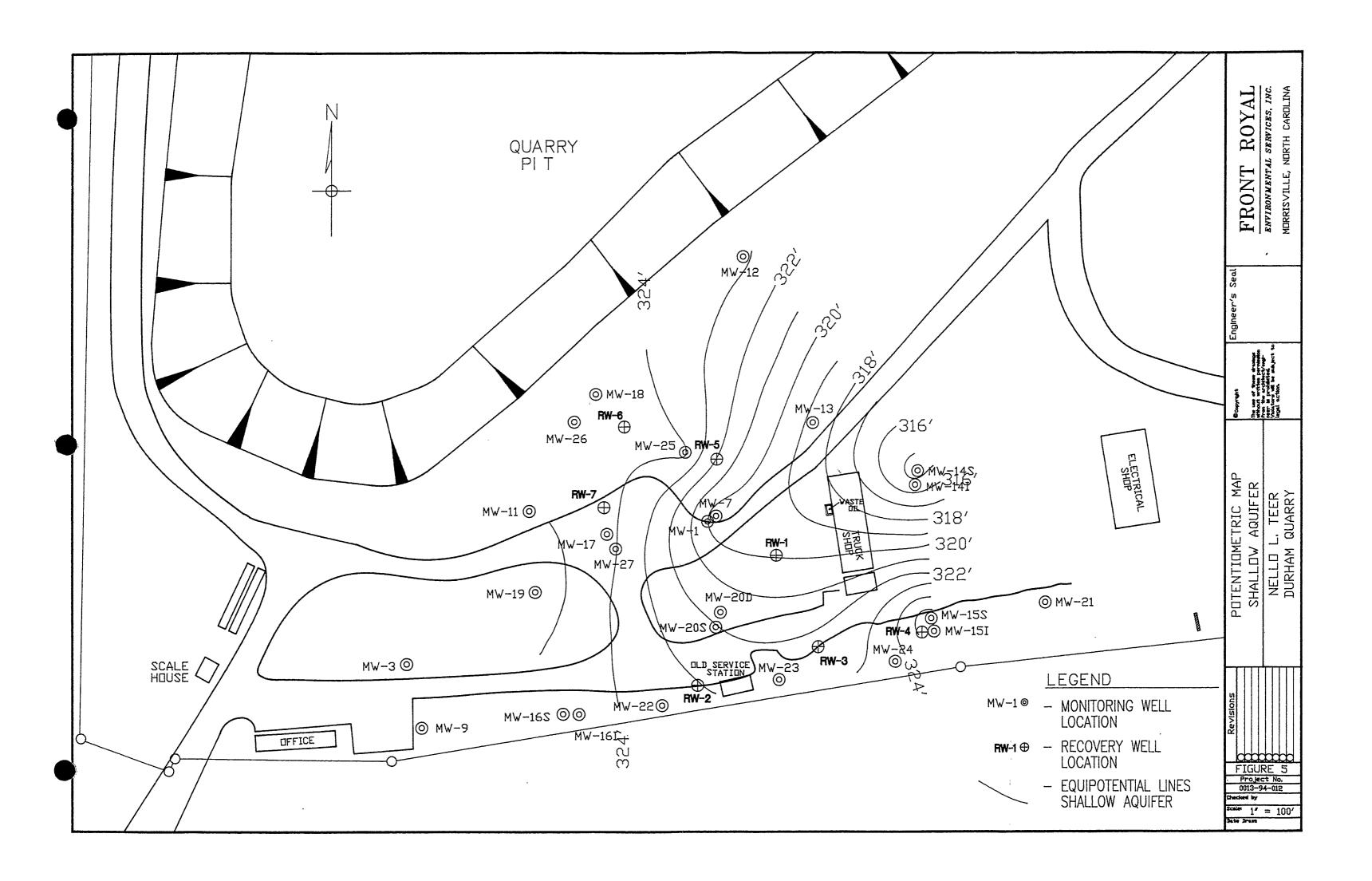


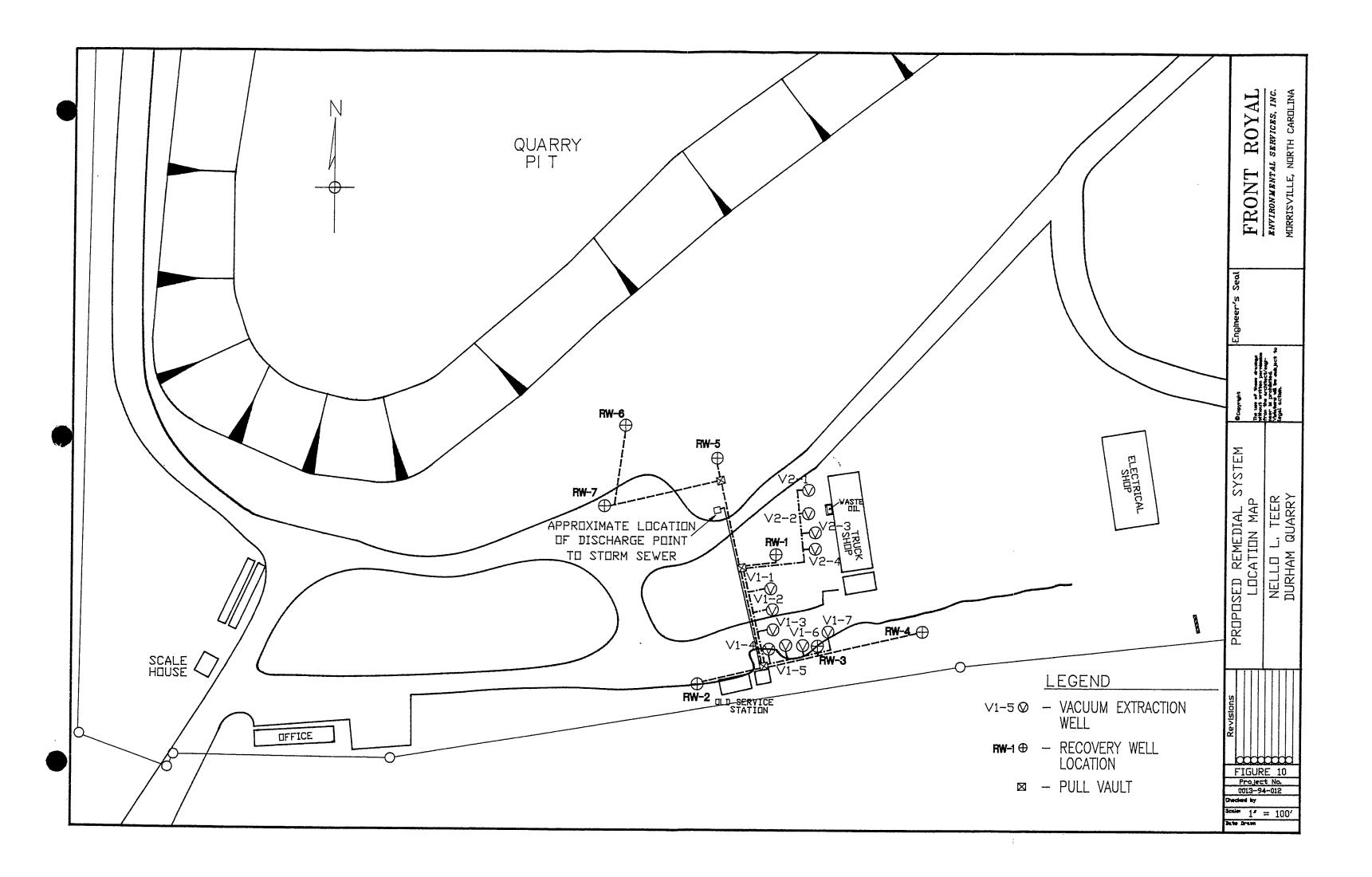


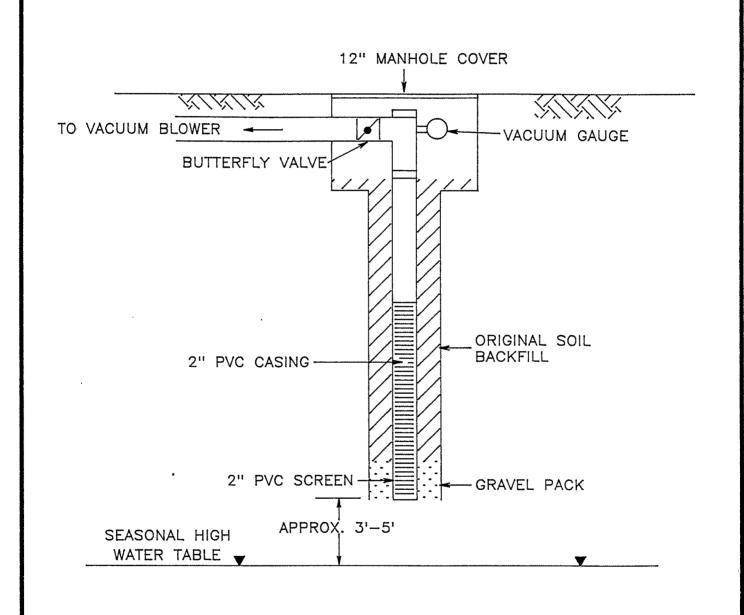












VACUUM WELL PROFILE

NELLO L. TEER QUARRY

DURHAM, NORTH CAROLINA

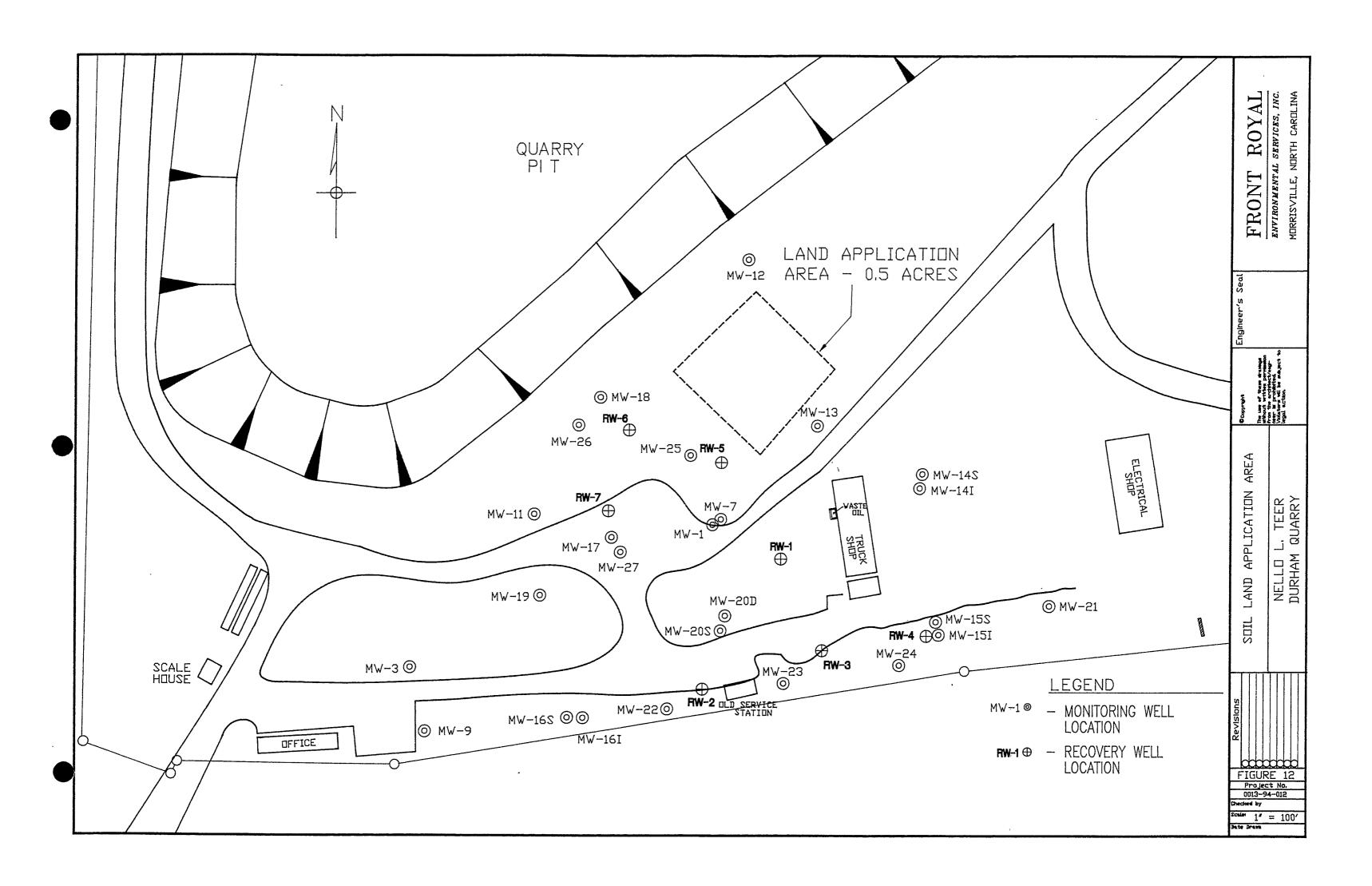
FRONT ROYAL

ENVIRONMENTAL SERVICES, INC.

FIGURE 11

SCALE: NTS

PROJ. # 0013-94-012



P-1 THROUGH P-7 - ELECTRIC, SUBMERSIBLE GROUND WATER RECOVERY PUMPS THIRD/FOURTH FUNCTION FIRST FUNCTION SECOND FUNCTION OW-1 - OIL/WATER SEPARATOR, 75 GPM T-1 - 55 GALLON FREE PRODUCT HOLDING DRUM FLOW T-2 - 500 GALLON FIBERGLASS FLOW EQUILIZATION TANK GLASS HAND HIGH INDICATOR P-8 - TRANSFER PUMP LOW REDUCING SWITCH RECORDER ST-1 - TRAY TYPE STRIPPING TOWER, 75 gpm TRANSMITTER VALVE O P-9 - TRANSFER PUMP VACUUM FR GAC-1 AND GAC-2 - LIQUID PHASE GRANULAR ACTIVATED CARBON OTHER ABBREVIATIONS USED
HOA - HAND-OFF-AUTOMATIC

1 - TOTALIZER AIR DISCHARGE PRV-1 WATER 2" PVC WATER FE-1 THROUGH HAND SWITCH SIGHT FLOW (HS-1 -PRODUCT HS-7 (SG) (1-1) RECOVERY PUMPS P-1 THROUGH P-7 N SUMP RECOVERY WELLS
RW-1 THROUGH RW-7 **FIGURE** DISCHARGE UNDER INDIVIDUAL NPDES PERMIT 13 **SCALE** NTS

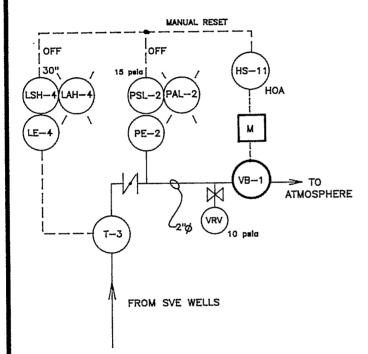
LEGEND

- - ELECTRICAL OR LOGIC LINES

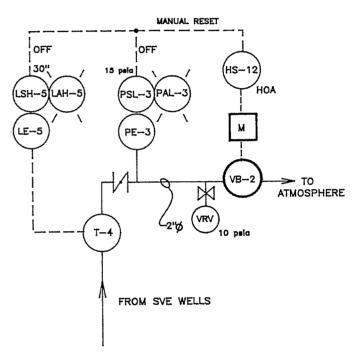
- - PIPING (LIQUID) OR PROCESS LINES

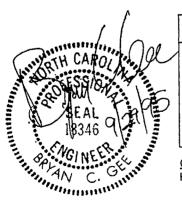
- EQUIPMENT

SVE-1



SVE-2





LETTER	FIRST FUNCTION	SECOND FUNCTION	THIRD/FOURTH FUNCTION
∢ E H ∟ P R Ø	HAND PRESSURE	ALARM ELEMENT RELIEF SWITCH	HIGH LOW
V	VACUUM	S	VALVE

OTHER ABBREVIATIONS USED HOA - HAND-OFF-AUTOMATIC

PIPING AND INSTRUMENTATION DIAGRAM — SVE SYSTEMS NELLO L. TEER QUARRY DURHAM, NORTH CAROLINA

FRONT ROYAL ENVIRONMENTAL SERVICES, INC.

FIGURE 14 scale: NTS

PROJ. # 0013-94-012

Table 1. Summary of Soil Laboratory Analytical Data Collected by Geonetics

				Parameters	
Boring	Sample	Boring	TPH	Gasoline	Diesel
Identification	Date	Depth	Method 5030	Method 3550	Method 3550
1401101110411041		(feet)	(ppm)	(ppm)	(ppm)
Former Asphalt	t Plant				
AP-1	01/06/94	0.5	740.0	<500.0	7,800.0
(RB-13)		3.0	3.5	<5.0	41.0
(100 10)		5.0	<3.0	<5.0	<5.0
		10.0	<3.0	<5.0	< 5.0
		15.0	<3.0	<5.0	<5.0
		20.0	<3.0	<5.0	<5.0
		25.0	<3.0	<5.0	<5.0
AD 2	01/06/94	8"	110.0	<5.0	341.0
AP-2	01/00/94	3.0	<3.0	<5.0	<5.0
(RB-14)		5.0	<3.0	<5.0	<5.0
		10.0	<3.0	<5.0	< 5.0
		15.0	<3.0	<5.0	<5.0
		20.0	<3.0	<5.0	<5.0
4 TO 0	01/06/04	0.5	147.0	<500.0	4,300.0
AP-3	01/06/94	3.0	<3.0	<5.0	<5.0
(RB-15)		5.0	<3.0	<5.0	< 5.0
		10.0	<3.0	<5.0	<5.0
		15.0	<3.0	<5.0	< 5.0
		20.0	<3.0	<5.0	<5.0
177.4	00/08/04	5.0	<3.0	<5.0	<5.0
AP-4	02/08/94	10.0	<3.0	<5.0	<5.0
(RB-16)		15.0	<3.0 <3.0	<5.0	84.0
		20.0	<3.0	<5.0	<5.0
	00/09/04	5.0	<3.0	<5.0	<5.0
AP-5 (RB-17)	02/08/94	8.0	<3.0	<5.0	<5.0
•	00/00/04	5.0	<3.0	<5.0	<5.0
RB-1	02/08/94	10.0	<3.0	<5.0	<5.0
		15.0	5.4	<5.0	<5.0
		20.0	8.1	<5.0	<5.0

all units in milligrams per kiligram (mg/kg)

Table 1. Summary of Soil Laboratory Analytical Data Collected by Geonetics

				Parameters	
Boring	Sample	Boring	TPH	Gasoline	Diesel
Identification	Date	Depth	Method 5030	Method 3550	Method 3550
1401111110411011	2400	(feet)	(ppm)	(ppm)	(ppm)
Former Asphalt	Plant				
RB-2	02/08/94	5.0	<3.0	<5.0	<5.0
		10.0	<3.0	<5.0	<5.0
		15.0	9.8	<5.0	<5.0
		20.0	<3.0	<5.0	<5.0
		25.0	<3.0	<5.0	<5.0
RB-3	02/09/94	5.0	<3.0	<5.0	<5.0
KD-3	02,00701	10.0	<3.0	<5.0	<5.0
		15.0	<3.0	<5.0	<5.0
		20.0	<3.0	<5.0	<5.0
RB-4	02/09/94	5.0	<3.0	<5.0	<5.0
KD-4	02/07/74	10.0	<3.0	<5.0	<5.0
	•	15.0	<3.0	<5.0	6.0
		20.0	<3.0	<5.0	<5.0
RB-5	02/16/94	5.0	<3.0	<5.0	10.0
KD-3	02/10/5	10.0	<3.0	<5.0	< 5.0
		15.0	<3.0	< 5.0	< 5.0
		20.0	<3.0	<5.0	<5.0
		25.0	<3.0	<5.0	<5.0
RB-6	02/16/94	5.0	<3.0	<5.0	<5.0
KD-0	02/10/54	10.0	14.2	<5.0	10.0
		15.0	<3.0	< 5.0	<5.0
		20.0	<3.0	<5.0	<5.0
		25.0	<3.0	<5.0	<5.0
RB-7	02/16/94	5.0	<3.0	<5.0	38.0
KD-/	02110171	10.0	25.0	<5.0	83.0
		15.0	<3.0	<5.0	21.0
		20.0	<3.0	<5.0	7.0
		25.0	<3.0	<5.0	<5.0

all units in milligrams per kiligram (mg/kg)

Table 1. Summary of Soil Laboratory Analytical Data Collected by Geonetics

				Parameters		
Boring	Sample	Boring	TPH	Gasoline	Diesel	
Identification	Date	Depth	Method 5030	Method 3550	Method 3550 (ppm)	
		(feet)	(ppm)	(ppm)		
Former Asphalt	Plant Area					
RB-8	02/17/94	5.0	6.1	<5.0	80.0	
		10.0	<3.0	<5.0	6.0	
		15.0	<3.0	<5.0	11.0	
		20.0	<3.0	<5.0	38.0	
RB- 9	02/17/94	5.0	<3.0	<5.0	<5.0	
KD >	<u> </u>	10.0	<3.0	<5.0	<5.0	
		15.0	<3.0	<5.0	<5.0	
		20.0	<3.0	<5.0	<5.0	
RB-10	02/17/94	5.0	<3.0	<5.0	<5.0	
KD-10	02/17/5	10.0	<3.0	<5.0	7.0	
		15.0	<3.0	<5.0	<5.0	
		20.0	<3.0	<5.0	<5.0	
RB-11	02/17/94	5.0	<3.0	<5.0	<5.0	
KD-11	02/1//5	10.0	<3.0	<5.0	` <5.0	
		15.0	<3.0	<5.0	<5.0	
		20.0	<3.0	<5.0	<5.0	
RB-12	02/17/94	5.0	<3.0	<5.0	<5.0	
100-12	024/ 1//5 .	10.0	<3.0	< 5.0	< 5.0	
		15.0	<3.0	< 5.0	<5.0	
		20.0	<3.0	< 5.0	<5.0	
	•	25.0	<3.0	<5.0	<5.0	
RB-17A	02/22/94	5.0	<3.0	<5.0	<5.0	
KD-1/A	 	10.0	<3.0	<5.0	<5.0	
SB-4	08/04/93	2 to 4	<0,275	<2.0	<2.0	
די-עט	00,07,73	5 to 7	0.3	<2.0	<2.0	
SB-5	08/04/93	2 to 4	<0.275	<2.0	<2.0	
ل∞رين	00,011,00	5 to 7	< 0.275	< 2.0	<2.0	
		10 to 12	< 0.275	< 2.0	<2.0	
		15 to 17	0.3	< 2.0	<2.0	

all units in milligrams per kiligram (mg/kg)

Table 1. Summary of Soil Laboratory Analytical Data Collected by Geonetics

			Parameters	
Sample	Boring	TPH	Gasoline	Diesel
Date	•			Method 3550
	(feet)	(ppm)	(ppm)	(ppm)
ain Field				
	2 to 4	2.5	200.0	<2.0
01102123		9.6	775.0	<2.0
		19.8	< 2.0	<2.0
		0.9	<2.0	<2.0
		0.5	<2.0	<2.0
	25 to 27	1.4	<2.0	<2.0
07/19/93	2 to 4	0.9	<2.0	<2.0
01115/55			<2.0	<2.0
		0.5	<2.0	< 2.0
		0.5	<2.0	<2.0
	20 to 22	0.5	<2.0	<2.0
	•	Date Depth (feet) ain Field 07/02/93 2 to 4 5 to 7 10 to 12 15 to 17 20 to 22 25 to 27 07/19/93 2 to 4 5 to 7 10 to 12 15 to 17	Date Depth (feet) Method 5030 (ppm) Ain Field 07/02/93 2 to 4 2.5 5 to 7 9.6 10 to 12 19.8 15 to 17 0.9 20 to 22 0.5 25 to 27 1.4 07/19/93 2 to 4 0.9 5 to 7 0.8 10 to 12 0.5 15 to 17 0.5	Date Depth (feet) Method 5030 (ppm) Method 3550 (ppm) ain Field 07/02/93 2 to 4 2.5 200.0 5 to 7 9.6 775.0 10 to 12 19.8 <2.0

Table 1. Summary of Soil Laboratory Analytical Data Collected by Geonetics

				Parameters	
Boring	Sample	Boring	TPH	Gasoline	Diesel
Identification	Date	Depth	Method 5030	Method 3550	Method 3550
Identification	15410	(feet)	(ppm)	(ppm)	(ppm)
Former Service	Station Area				3 T A
TP-2	06/15/93	Comp	7.6	<2.0	NA
TP-3	06/15/93	Comp	0.6	<2.0	NA
TP-4	06/15/93	Comp	0.5	<2.0	NA
TP-5	06/15/93	Comp	0.8	<2.0	NA
SB-2	'07/20/94	2 to 4	0.4	<2.0	<2.0
3D-2	07/20/21	5 to 7	0.4	<2.0	<2.0
		10 to 12	0.6	<2.0	<2.0
		15 to 17	0.4	<2.0	< 2.0
		20 to 22	63.0	31.0	<2.0
CD 2*	08/04/93	2 to 4	<0.275	<2.0	225.0 mg/k
SB-3*	00/04/23	5 to 7	< 0.275	<2.0	105.0 mg/k
		10 to 12	< 0.275	<2.0	132.0 mg/k
		15 to 17	0.4	< 2.0	90.3 mg/k
		20 to 22	0.3	<2.0	167.0 mg/k
DXX 2	12/10/93	5.0	<3.0	<5.0	<5.0
RW-3	12/10/93	10.0	4.8	<5.0	<5.0
		15.0	74.2	<5.0	240.0
		20.0	151.0	<5.0	80.0
		25.0	4.0	<5.0	<5.0
		30.0	3.0	<5.0	<5.0
DXX 4	12/11/93	6.0	6.2	<5.0	<5.0
RW-4	12/11/93	11.0	<3.0	<5.0	<5.0
		16.0	6.3	<5.0	<5.0
	••	21.0	<3.0	<5.0	< 5.0
		26.0	<3.0	<5.0	< 5.0
		31.0	<3.0	<5.0	<5.0

^{*-} SB-3 was analyzed for oil & grease using EPA Method 9071

Table 1. Summary of Soil Laboratory Analytical Data Collected by Geonetics

				Parameters	
Boring	Sample	Boring	TPH	Gasoline	Diesel
Identification	Date	Depth	Method 5030	Method 3550	Method 3550
		(feet)	(ppm)	(ppm)	(ppm)
Former Service	Station Area				
RB3-1	04/20/94	5.0	<3.0	<10.0	<10.0
		10.0	<3.0	<10.0	<10.0
		15.0	<3:0	<10.0	<10.0
		20.0	<3.0	<10.0	<10.0
RB3-2	04/20/94	5.0	<3.0	<10.0	<10.0
		10.0	<3.0	<10.0	<10.0
		15.0	<3.0	<10.0	<10.0
		20.0	<3.0	<10.0	<10.0
RB3-3	04/20/94	5.0	<3.0	<10.0	33.0
1000	• <u>-</u>	10.0	130.0	<10.0	1148.0
		15.0	<3.0	<10.0	54.0
		20.0	<3.0	<10.0	<10.0
		25.0	4.0	<10.0	110.0

Table 1. Summary of Soil Laboratory Analytical Data Collected by Geonetics

<u></u>	<u>, , , , , , , , , , , , , , , , , , , </u>			Parameters		
Boring	Sample	Boring	TPH	Gasoline	Diesel	
Identification	Date	Depth	Method 5030	Method 3550	Method 3550 (ppm)	
		(feet)	(ppm)	(ppm)		
Former Service	Station Area				410.0	
RB3-4	04/21/94	5.0	<3.0	<10.0	<10.0	
		10.0	53.0	<10.0	420.0	
		15.0	43.0	<10.0	566.0	
RB3-5	04/21/94	5.0	<3.0	<10.0	<10.0	
1005-5	0112215	10.0	<3.0	<10.0	<10.0	
		15.0	5.3	<10.0	35.0	
		20.0	3.0	<10.0	13.0	
		25.0	<3.0	<10.0	<10.0	
		30.0	<3.0	<10.0	<10.0	
		35.0	<3.0	<10.0	<10.0	
DD2 (04/21/94	5.0	<3.0	<10.0	41.0	
RB3-6	04/21/94	10.0	<3.0	<10.0	33.0	
		15.0	<3.0	<10.0	<10.0	
	•	20.0	71.0	130.0	15.0	
	04/05/04	5.0	<3.0	<10.0	<10.0	
RB3-7	04/25/94	10.0	<3.0	<10.0	<10.0	
		15.0	<3.0	<10.0	<10.0	
		20.0	53.0	<10.0	409.0	
		25.0	<3.0	<10.0	22.0	
	0.4.10.5.10.4	5.0	<3.0	<10.0	<10.0	
RB3-8	04/25/94	5.0	<3.0 <3.0	<10.0	<10.0	
		10.0	<3.0 <3.0	<10.0	<10.0	
		15.0	11.0	<10.0	48.0	
		20.0	<3.0	<10.0	11.0	
,	••	25.0 30.0	<3.0 <3.0	<10.0	<10.0	
		. ^	~2 A	<10.0	<10.0	
RB3-9	04/25/94	5.0	<3.0	<10.0 <10.0	<10.0	
		10.0	<3.0	<10.0	<10.0	
	•	15.0	<3.0	<10.0 <10.0	<10.0	
		20.0	<3.0	<10.0 <10.0	<10.0	
		25.0	<3.0		<10.0 <10.0	
		30.0	<3.0	<10.0	~10.0	

Table 1. Summary of Soil Laboratory Analytical Data Collected by Geonetics

			Paran	neters
Boring	Sample	Boring	Oil & Grease	Total VOA
Identification	Date	Depth	Method 9071	Method 8021
		•	(mg/l)	(μg/kg)
			•	
Truck Shop Ar	rea			" ~ C
B-85	05/25/93	5.0	572.0	53.6
D 06	05/25/93	10.0	113.0	82.7
B-86	03123193	15.0	172.0	76.6
		20.0	54.5	92.7
Near B-86	05/25/93	2.5	122.0	73.8
D 07	05/25/93	5.0	183.0	71.8
B-87	03/23/93	7.0	128.0	116.6
		.,.		
TP-1	05/25/93	2.5	ND	97.3

mg/l - milligrams per liter μg/l - micrograms per liter

Table 1. Summary of Soil Laboratory Analytical Data Collected by Geonetics

				Parameters	
Boring	Sample	Boring	TPH	Gasoline	Diesel
Identification	Date	Depth	Method 5030	Method 3550	Method 3550
		(feet)	(ppm)	(ppm)	(ppm)
East of Former	Service Station	Area			
D-1	06/15/93	Comp	24.2	<5.0	820.0
D-2	06/15/93	Comp .	1.4	<2.0	22.0
D-3	06/15/93	Comp	0.4	<5.0	340.0
D-4	06/15/93	Comp	116.8	<25.0	2,800.0
D-5	06/15/93	Comp	0.4	<2.0	<2.0
D-6	06/15/93	Comp	0.3	<2.0	<2.0
D-7	06/15/93	Comp	1.1	<2.0	<2.0
D-8	06/15/93	Comp	0.6	<2.0	<2.0
Southern Prop	erty Boundary				
D-9	06/15/93	Comp	0.3	<2.0	<2.0
D-10	06/15/93	Comp	0.4	<2.0	<2.0
D-11	06/15/93	Comp	10.7	<2.0	<2.0
TP-6	06/17/93	Comp	0.6	<2.0	<2.0
TP-7	06/17/93	Comp	0.1	<2.0	<2.0
Southern Prop	erty Boundary				
D-12	06/16/93	Comp	0.5	<2.0	<2.0
D-13	06/16/93	Comp	0.6	<2.0	<2.0
D-14	06/16/93	Comp	0.4	<2.0	<2.0
TP-8	06/17/93	Comp	0.5	<2.0	<2.0
TP-9	06/17/93	Comp	0.7	<20.0	2,000.0

Table 2. Depth to Water Data

		Depth to
Well	Well	Water From
Number	Depth	Top of Casing
RW-2	51.4	20.45
RW-3	94.8	NM
RW-4	93.0	NM
MW-1	37.9	14.02
MW-3	74.0	27.89
MW-7	17.3	10.79
MW-9	40.8	23.27
MW-11	50.8	35.53
MW-12	21.2	7.58
MW-13	66.3	23.60
MW-14S	20.4	13.41
MW-14I	49.8	22.94
MW-15S	17.5	4.32
MW-15I	40.8	15.99
MW-16S	11.9	10.21
MW-16I	60.2	22.71
MW-17	12.5	4.00
MW-18	14.3	4.95
MW-19	13.3	3.15
MW-20S	33.7	17.82
MW-20D	115.0	26.55
MW-21	70.0	15.63
MW-22	60.6	20.11
MW-23	60.5	19.62
MW-24	37.8	14.82
MW-25	14.5	5.35
MW-26	13.3	5.67
MW-27	21.5	NM

NM - Not Measured

Data collected by Front Royal Personnel in April 1995

Table 3. Ground Water Laboratory Analytical Data - April 1995

Shallow Ag	uifer						1,1-	1,1-	Tri-	1,1,1-	cis-1,2-
Well			Ethyl-		Naph-	Chloro-	Dichloro-	Dichloro	chloro-	Trichloro-	Dichloro-
Number	Benzene	Toluene	Benzene	Xylenes	thalene	form	ethane	ethene	ethene	ethane	ethylene
Number	DCIIZCIIC	10140440									DDI
MW-7	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
MW-12	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
MW-14S	BDL	BDL	BDL	BDL	BDL	BDL	BDL	\mathtt{BDL}	BDL	BDL	BDL
	BDL	BDL	56.3	188.0	53.4	BDL	BDL	BDL	BDL	BDL	BDL
MW-15S	BDL	BDL	BDL	BDL	BDL	$_{ m BDL}$	BDL	BDL	BDL	BDL	BDL
MW-16S	BDL	BDL	BDL	BDL	BDL	\mathtt{BDL}	23.3	BDL	BDL	BDL	2.1
MW-17	BDL	BDL	BDL	BDL	BDL	3.4	97.9	BDL	BDL	BDL	1.4
MW-18	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
MW-19	71.8	BDL	14.6	20.6	4.9	BDL	BDL	BDL	BDL	BDL	BDL
MW-20S		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
MW-24	BDL	BDL	BDL	BDL	2.2	102.0	632.0	708.0	267.0	2,709.0	319.0
MW-25	BDL	BDL	BDL	BDL	BDL	BDL	109.0	8.1	BDL	BDL	4.9
MW-26	BDL	שטע	טטט	BDL	222						
NCAC 2L Standard	1.0	1,000.0	29.0	530.0	21.0	0.19	700.0	7.0	2.8	200.0	70.0

All units in micrograms per liter (µg/l)
Bold indicates contaminant level in excess of NCAC 2L Standard

Analysis performed by Hydrologic, Inc.

BDL - Below method detection limits

Table 3. Ground Water Laboratory Analytical Data - April 1995

Deep Aquif	er						1,1-	1,1-	Tri-	1,1,1-	cis-1,2-
337-11			Ethyl-		Naph-	Chloro-	Dichloro-	Dichloro	chloro-	Trichloro-	Dichloro-
Well	Benzene	Toluene	Benzene	Xylenes	thalene	form	ethane	ethene	ethene	ethane	ethylene
Number	Delizerie	TOIGCIE	Bonzone	, 12)10110							
MW-1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
MW-3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
MW-9	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.3
MW-11	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.8	BDL	22.9
MW-13	BDL	BDL	BDL	BDL	BDL	BDL	13.2	2.3	4.1	BDL	3.4
MW-14I	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
MW-15I	BDL	BDL	1.9	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
MW-16I	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
MW-20D	29.8	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	5.2
MW-21	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
MW-22	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
MW-23	67.9	14.5	40.4	95.3	42.9	BDL	BDL	BDL	BDL	BDL	BDL
RW-1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
RW-2	95.0	19.0	62.0	61.0	2.8	BDL	BDL	BDL	BDL	BDL	90.0
2000							•				
NCAC 2L		1 000 0	20.0	£20.0	21.0	0.19	700.0	7.0	2.8	200.0	70.0
Standard	1.0	1,000.0	29.0	530.0	21.0	0.17	,00.0		_••		

All units in micrograms per liter (µg/l)
Bold indicates contaminant level in excess of NCAC 2L Standard
Analysis performed by Hydrologic, Inc.
BDL - Below method detection limits

Table 4. Summary of Historical Ground Water Analytical Data

W-1*

Constituent	Date						
	05/07/93	05/07/93	05/20/93	05/20/93			
Benzene	16.0	38.8	34.4	11.3			
Toluene	0.9	1.0	1.8	2.6			
Ethylbenzene	0.4	1.0	1.0	8.8			
Xylenes	5.1	15.4	17.2	NA			
MTBE	NA	51.6	11.8	BDL			
EDB	NA	NA	BDL	BDL			
IPE	NA	NA	NA	\mathtt{BDL}			
Total PAH	NA	NA	BDL	NA			
1,1-Dichloroethane	NA	0.7	0.7	\mathtt{BDL}			
Trichloroethene	NA	4.7	5.0	BDL			
cis-,1,2-Dichloroethylene	NA	NA	NA	NA			
Vinyl Chloride	BDL	BDL	BDL	BDL			
Naphthalene	NA	NA	2.0	NA			
Lead	NA	NA	1.0	BDL			

^{*} W-1 abandoned in October 1994

W-2

Constituent	Date
	05/18/93
Benzene	BDL
Toluene	BDL
Ethylbenzene	BDL
Xylenes	BDL
MTBE	BDL
EDB	BDL
IPE	BDL
Total PAH	BDL
1,1-Dichloroethane	BDL
Trichloroethene	BDL
cis-,1,2-Dichloroethylene	NA
Vinyl Chloride	BDL
Naphthalene	BDL
Lead	0.50

All units in micrograms per liter (µg/l)

NA - Not Analyzed

BDL - Below Method Detection Limits

Front Royal Project 0013-94-012

Table 4. Summary of Historical Ground Water Analytical Data

W-3

Constituent	Date
Constituent	
	05/19/93
Benzene	BDL
Toluene	BDL
Ethylbenzene	0.90
Xylenes	BDL
MTBE	BDL
EDB	BDL
IPE	BDL
Total PAH	BDL
1,1-Dichloroethane	BDL
Trichloroethene	BDL
cis-,1,2-Dichloroethylene	NA
Vinyl Chloride	BDL
Naphthalene	BDL
Lead	0.50

W-4

Constituent	Date
	05/19/93
Benzene	BDL
Toluene	BDL_{\cdot}
Ethylbenzene	BDL
Xylenes	BDL
MTBE	BDL
EDB	BDL
IPE	BDL
Total PAH	BDL
1,1-Dichloroethane	BDL
Trichloroethene	BDL
cis-,1,2-Dichloroethylene	NA
Vinyl Chloride	BDL
Naphthalene	BDL
Lead	BDL

All units in micrograms per liter (µg/l) NA - Not Analyzed BDL - Below Method Detection Limits Front Royal Project 0013-94-012 139412-4.wk4

Table 4. Summary of Historical Ground Water Analytical Data

W-5

11 3						
Constituent	Date					
	05/20/93	05/20/93	05/20/93			
Benzene	BDL	BDL	BDL			
Toluene	0.7	BDL	\mathtt{BDL}			
Ethylbenzene	BDL	BDL	\mathtt{BDL}			
Xylenes	BDL	BDL	NA			
MTBE	BDL	BDL	\mathtt{BDL}			
EDB	BDL	1.0	BDL			
IPE	BDL	NA	BDL			
Total PAH	BDL	BDL	NA			
1,1-Dichloroethane	BDL	1.0	\mathtt{BDL}			
Trichloroethene	BDL	2.1	BDL			
cis-,1,2-Dichloroethylene	NA	NA	NA			
Vinyl Chloride	BDL	1.0	BDL			
Naphthalene	BDL	2.0	NA			
Lead	0.20	1.00	BDL			

MW-1

Constituent			Dat	e		
	05/20/93	05/20/93	05/20/93	08/29/94	01/26/95	04/27/95
Benzene	BDL	BDL	BDL	BDL	BDL	\mathtt{BDL}
Toluene	BDL	\mathtt{BDL}	0.70	BDL	BDL	\mathtt{BDL}
Ethylbenzene	BDL	BDL	BDL	BDL	BDL	\mathtt{BDL}
Xylenes	NA	NA	\mathtt{BDL}	NA	\mathtt{BDL}	\mathtt{BDL}
MTBE	BDL	BDL	\mathtt{BDL}	NA	BDL	NA
EDB	BDL	BDL	NA	NA	NA	NA
IPE	BDL	BDL	NA	NA	NA	NA
Total PAH	NA	NA	BDL	BDL	NA	NA
1,1-Dichloroethane	BDL	BDL	BDL	BDL	BDL	BDL
Trichloroethene	BDL	\mathtt{BDL}	BDL	BDL	\mathtt{BDL}	BDL
cis-,1,2-Dichloroethylene	NA	NA	NA	BDL	\mathtt{BDL}	BDL
Vinyl Chloride	BDL	BDL	BDL	\mathtt{BDL}	BDL	BDL
Naphthalene	2.00	NA	NA	\mathtt{BDL}	BDL	BDL
Lead	1.00	0.03	NA	BDL	NA	NA

All units in micrograms per liter ($\mu g/l$)

NA - Not Analyzed

BDL - Below Method Detection Limits

Front Royal Project 0013-94-012

Table 4. Summary of Historical Ground Water Analytical Data

RW-2

RW-Z			Date			
Constituent	05/07/93	05/07/93	05/20/93	05/20/93	05/20/93	08/29/94
Damaga	575.0	672.0	541.0	252.0	353.0	95.0
Benzene	1,160.0	892.0	521.0	319.0	418.0	19.0
Toluene	84.4	16.0	89.0	16.0	BDL	62.0
Ethylbenzene	1,425.0	1,530.0	855.0	NA	106.0	61.0
Xylenes MTBE	NA	23.0	105.0	\mathtt{BDL}	BDL	NA
EDB	NA	NA	BDL	BDL	BDL	NA
IPE	NA	NA	NA	BDL	BDL	NA
Total PAH	NA	NA	BDL	NA	BDL	NA
1,1-Dichloroethane	NA	4.0	BDL	BDL	BDL	BDL
Trichloroethene	NA	4.0	\mathtt{BDL}	BBDL	BDL	BDL
cis-,1,2-Dichloroethylene	NA	NA	NA	NA	NA	90.0
Vinyl Chloride	NA	4.0	BDL	BDL	BDL	BDL
Naphthalene	NA	NA	2.0	NA	NA	2.8
Lead	NA	NA	1.00	BDL	0.20	<u>NA</u>

MW-3

Constituent	Date						
	05/21/93	08/29/94	01/26/95	04/27/95			
Benzene	BDL	\mathtt{BDL}	BDL	\mathtt{BDL}			
Toluene	BDL	\mathtt{BDL}	BDL	\mathtt{BDL}			
Ethylbenzene	BDL	BDL	BDL	BDL			
Xylenes	BDL	\mathtt{BDL}	BDL	\mathtt{BDL}			
MTBE	\mathtt{BDL}	\mathtt{BDL}	BDL	NA			
EDB	BDL	NA	NA	NA			
IPE .	BDL	NA	NA	NA			
Total PAH	BDL	NA	NA	NA			
1,1-Dichloroethane	BDL	BDL	\mathtt{BDL}	BDL			
Trichloroethene	BDL	BDL	\mathtt{BDL}	BDL			
cis-,1,2-Dichloroethylene	NA	BDL	BDL	BDL			
Vinyl Chloride	BDL	BDL	BDL	BDL			
Naphthalene	BDL	BDL	BDL	\mathtt{BDL}			
Lead	0.06	NA	NA	NA			
Leau	0.00						

All units in micrograms per liter (µg/l)
NA - Not Analyzed
BDL - Below Method Detection Limits
Front Royal Project 0013-94-012
139412-4.wk4

Table 4. Summary of Historical Ground Water Analytical Data

TAT AA	
Constituent	Date
	05/18/93
Benzene	\mathtt{BDL}
Toluene	0.70
Ethylbenzene	BDL
Xylenes	BDL
MTBE	BDL
EDB	BDL
IPE	BDL
Total PAH	BDL
1,1-Dichloroethane	BDL
Trichloroethene	BDL
cis-,1,2-Dichloroethylene	NA
Vinyl Chloride	BDL
Naphthalene	BDL
Lead	0.50

MW-5

		Date		
7/93	05/07/93	05/20/93	05/20/93	05/20/93
	BDL	BDL	1.5	BDL
	BDL	BDL	4.4	BDL
		BDL	6.5	BDL
			NA	\mathtt{BDL}
			BDL	\mathtt{BDL}
			BDL	BDL
				BDL
NA				NA
NA				
NA	\mathtt{BDL}			BDL
NA	NA	NA		BDL
NA	NA	1.00	BDL	0.07
	NA NA	BDL	7/93 05/07/93 05/20/93 BDL NA BDL BDL NA NA BDL NA NA BDL NA NA BDL NA BDL BDL NA NA NA BDL NA BDL BDL NA NA NA NA NA NA NA NA	7/93 05/07/93 05/20/93 05/20/93 BDL BDL BDL 1.5 BDL BDL BDL 4.4 BDL BDL BDL 6.5 BDL BDL BDL BDL NA BDL BDL BDL NA NA BDL BDL NA NA BDL NA NA BDL BDL BDL NA BDL BDL BDL NA NA NA NA NA BDL BDL BDL NA NA NA NA NA NA NA NA

All units in micrograms per liter (µg/l) NA - Not Analyzed

BDL - Below Method Detection Limits

Front Royal Project 0013-94-012

Table 4. Summary of Historical Ground Water Analytical Data

MW-0	
Constituent	Date
	05/21/93
Benzene	BDL
Toluene	BDL
Ethylbenzene	BDL
Xylenes	BDL
MTBE	BDL
EDB	BDL
IPE	BDL
Total PAH	BDL
1,1-Dichloroethane	BDL
Trichloroethene	BDL
cis-,1,2-Dichloroethylene	NA
Vinyl Chloride	BDL
Naphthalene	NA
Lead	0.03

MW-7

MW-/				
Constituent		Date		
001101101	05/21/93	08/29/94	01/26/95	04/27/95
Benzene	BDL	\mathtt{BDL}	BDL	BDL
Toluene	BDL	BDL	BDL	\mathtt{BDL}
Ethylbenzene	BDL	\mathtt{BDL}	BDL	\mathtt{BDL}
Xylenes	BDL	BDL	BDL	BDL
MTBE	BDL	NA	NA	NA
EDB	BDL	NA	NA	NA
IPE	$\overline{\mathrm{BDL}}$	NA	NA	NA
Total PAH	BDL	NA	NA	NA
1,1-Dichloroethane	BDL	BDL	\mathtt{BDL}	BDL
Trichloroethene	BDL	BDL	BDL	BDL
cis-,1,2-Dichloroethylene	NA	BDL	BDL	BDL
	BDL	BDL	BDL	BDL
Vinyl Chloride	BDL	BDL	BDL	BDL
Naphthalene	0.02	NA	NA	NA
Lead	0.02			

All units in micrograms per liter (µg/l) NA - Not Analyzed BDL - Below Method Detection Limits

Front Royal Project 0013-94-012

Table 4. Summary of Historical Ground Water Analytical Data

Date
05/19/93
BDL
\mathtt{BDL}
BDL
NA
BDL
NA
0.05

MW-9

Constituent		Dat	e	
	09/09/93	08/30/94	01/26/95	04/27/95
Benzene	BDL	BDL	BDL	BDL
Toluene	\mathtt{BDL}	BDL	BDL	BDL
Ethylbenzene	BDL	BDL	BDL	BDL
Xylenes	NA	BDL	BDL	BDL
MTBE	BDL	NA	NA	ΝA
EDB	BDL	NA	NA	NA
IPE	\mathtt{BDL}	NA	NA	NA
Total PAH	BDL	NA	NA	NA
1,1-Dichloroethane	\mathtt{BDL}	BDL	BDL	BDL
Trichloroethene	BDL	\mathtt{BDL}	BDL	BDL
cis-,1,2-Dichloroethylene	NA	BDL	BDL	BDL
Vinyl Chloride	BDL	BDL	BDL	BDL
Naphthalene	BDL	BDL	BDL	BDL
Lead	0.05	NA	NA	NA

All units in micrograms per liter (μ g/l)

NA - Not Analyzed

BDL - Below Method Detection Limits

Front Royal Project 0013-94-012

Table 4. Summary of Historical Ground Water Analytical Data

IAT AA - 1 1					
Constituent	Date				
	09/09/93	08/30/94	01/26/95	04/27/95	
Benzene	BDL	BDL	BDL	\mathtt{BDL}	
Toluene	BDL	BDL	BDL	\mathtt{BDL}	
Ethylbenzene	BDL	\mathtt{BDL}	BDL	BDL	
Xylenes	NA	\mathtt{BDL}	BDL	BDL	
MTBE	BDL	NA	NA	NA	
EDB	BDL	NA	NA	NA	
IPE	BDL	NA	NA	NA	
Total PAH	BDL	NA	NA	NA	
1,1-Dichloroethane	0.6	BDL	BDL	BDL	
Trichloroethene	BDL	BDL	2.5	1.8	
cis-,1,2-Dichloroethylene	NA	BDL	BDL	1.3	
Vinyl Chloride	BDL	BDL	\mathtt{BDL}	BDL	
Naphthalene	BDL	BDL	\mathtt{BDL}	BDL	
Lead	NA	NA	NA	NA	
Leau	1121				

MW-12

Constituent		Date	e	
Condition	09/09/93	08/30/94	01/26/95	04/27/95
Benzene	BDL	\mathtt{BDL}	BDL	\mathtt{BDL}
Toluene	BDL	BDL	BDL	\mathtt{BDL}
Ethylbenzene	BDL	\mathtt{BDL}	BDL	\mathtt{BDL}
Xylenes	NA	BDL	BDL	\mathtt{BDL}
MTBE	BDL	NA	NA	NA
EDB	BDL	NA	NA	NA
IPE	BDL	NA	NA	NA
Total PAH	BDL	NA	NA	NA
1,1-Dichloroethane	BDL	\mathtt{BDL}	BDL	BDL
Trichloroethene	BDL	BDL	BDL	BDL
cis-,1,2-Dichloroethylene	NA	BDL	BDL	BDL
Vinyl Chloride	BDL	BDL	BDL	BDL
Naphthalene	BDL	BDL	BDL	BDL
Lead	NA	NA	NA	NA

All units in micrograms per liter (µg/l)

NA - Not Analyzed

BDL - Below Method Detection Limits

Front Royal Project 0013-94-012

Table 4. Summary of Historical Ground Water Analytical Data

Constituent	Date			
Constituent	09/09/93	08/31/94	01/26/95	04/27/95
Benzene	BDL	3.1	BDL	BDL
Toluene	BDL	\mathtt{BDL}	\mathtt{BDL}	BDL
Ethylbenzene	BDL	BDL	BDL	BDL
Xylenes	NA	\mathtt{BDL}	BDL	BDL
MTBE	BDL	NA	NA	NA
EDB	BDL	NA	NA	NA
IPE	BDL	NA	NA	NA
Total PAH	\mathtt{BDL}	NA	NA	NA
1,1-Dichloroethane	4.4	6.0	7.9	13.2
Trichloroethene	BDL	5.1	BDL	4.1
cis-,1,2-Dichloroethylene	NA	3.4	BDL	22.9
Vinyl Chloride	\mathtt{BDL}	\mathtt{BDL}	BDL	BDL
Naphthalene	\mathtt{BDL}	\mathtt{BDL}	BDL	BDL
Lead	NA	NA	NA	NA

MW-14S

Constituent		Date	e	
	09/09/93	08/30/94	01/31/95	04/26/95
Benzene	BDL	\mathtt{BDL}	BDL	BDL
Toluene	\mathtt{BDL}	BDL	BDL	BDL
Ethylbenzene	BDL	\mathtt{BDL}	\mathtt{BDL}	BDL
Xylenes	NA	BDL	BDL	BDL
MTBE	BDL	NA	NA	NA
EDB	\mathtt{BDL}	NA	NA	NA
IPE	\mathtt{BDL}	NA	NA	NA
Total PAH	\mathtt{BDL}	NA	NA	NA
1,1-Dichloroethane	\mathtt{BDL}	BDL	BDL	BDL
Trichloroethene	\mathtt{BDL}	\mathtt{BDL}	BDL	BDL
cis-,1,2-Dichloroethylene	NA	\mathtt{BDL}	BDL	BDL
Vinyl Chloride	BDL	\mathtt{BDL}	BDL	BDL
Naphthalene	BDL	BDL	BDL	BDL
Lead	0.05	NA	NA	NA

All units in micrograms per liter ($\mu g/l$)

NA - Not Analyzed

BDL - Below Method Detection Limits

Front Royal Project 0013-94-012

Table 4. Summary of Historical Ground Water Analytical Data

MW-14I

C ///	Date			
Constituent	09/09/93	08/30/94	01/31/95	04/26/95
Benzene	BDL	BDL	BDL	BDL
Toluene	BDL	BDL	BDL	BDL
Ethylbenzene	BDL	BDL	BDL	BDL
Xylenes	NA	BDL	BDL	BDL
MTBE	BDL	NA	NA	NA
EDB	BDL	NA	NA	NA
IPE	BDL	NA	NA	NA
Total PAH	\mathtt{BDL}	NA	. NA	NA
1,1-Dichloroethane	BDL	BDL	\mathtt{BDL}	BDL
Trichloroethene	BDL	BDL	\mathtt{BDL}	BDL
cis-,1,2-Dichloroethylene	NA	BDL	\mathtt{BDL}	BDL
Vinyl Chloride	\mathtt{BDL}	\mathtt{BDL}	BDL	BDL
Naphthalene	BDL	BDL	\mathtt{BDL}	BDL
Lead	0.05	NA	NA	NA

MW-15S

Constituent	Date			
- CONSTRUCTION OF THE CONTRACT	09/09/93	08/31/94	01/26/95	04/26/95
Benzene	10.7	17.5	\mathtt{BDL}	\mathtt{BDL}
Toluene	8.8	2.6	BDL	\mathtt{BDL}
Ethylbenzene	76.4	147.0	43.0	53.6
Xylenes	NA	430.0	170.0	188.0
MTBE	8.3	NA	NA	NA
EDB	BDL	NA	NA	NA
IPE	BDL	NA	NA	NA
Total PAH	13.0	NA	NA	NA
1,1-Dichloroethane	BDL	\mathtt{BDL}	BDL	BDL
Trichloroethene	BDL	\mathtt{BDL}	\mathtt{BDL}	BDL
cis-,1,2-Dichloroethylene	NA	BDL	BDL	BDL
Vinyl Chloride	BDL	BDL	BDL	BDL
Naphthalene	13.0	63.3	60.9	54.3
Lead	0.05	NA	NA	NA NA

All units in micrograms per liter ($\mu g/l$)

NA - Not Analyzed

BDL - Below Method Detection Limits

Front Royal Project 0013-94-012

Table 4. Summary of Historical Ground Water Analytical Data

MW-15I

MW-131				
Constituent		Date		
	09/09/93	08/31/94	01/26/95	04/26/95
Benzene	BDL	BDL	\mathtt{BDL}	\mathtt{BDL}
Toluene	BDL	BDL	\mathtt{BDL}	BDL
Ethylbenzene	BDL	2.7	3.4	1.9
Xylenes	NA	3.6	9.0	\mathtt{BDL}
MTBE	BDL	NA	NA	NA
EDB	BDL	NA	NA	NA
IPE	BDL	NA	NA	NA
Total PAH	BDL	NA	NA	NA
1,1-Dichloroethane	BDL	\mathtt{BDL}	BDL	BDL
Trichloroethene	BDL	\mathtt{BDL}	BDL	BDL
cis-,1,2-Dichloroethylene	NA	\mathtt{BDL}	BDL	BDL
Vinyl Chloride	BDL	\mathtt{BDL}	BDL	BDL
Naphthalene	BDL	63.3	BDL	BDL
Lead	0.05	NA	NA	NA_

MW-16S

Constituent	Date				
- COMMUNICATION CONTRACTOR CONTRA	09/09/93	08/30/94	04/27/95		
Benzene	BDL	\mathtt{BDL}	BDL		
Toluene	BDL	BDL	BDL		
Ethylbenzene	BDL	\mathtt{BDL}	BDL		
Xylenes	NA	BDL	\mathtt{BDL}		
MTBE	BDL	NA	NA		
EDB	BDL	NA	NA		
IPE	\mathtt{BDL}	NA	NA		
Total PAH	\mathtt{BDL}	NA	NA		
1.1-Dichloroethane	BDL	BDL	BDL		
Trichloroethene	BDL	BDL	BDL		
cis-,1,2-Dichloroethylene	NA	BDL	BDL		
Vinyl Chloride	BDL	\mathtt{BDL}	BDL		
Naphthalene	BDL	\mathtt{BDL}	BDL		
Lead	0.05	NA	NA		

All units in micrograms per liter (µg/l)

NA - Not Analyzed

BDL - Below Method Detection Limits

Front Royal Project 0013-94-012

Table 4. Summary of Historical Ground Water Analytical Data

MW-16I

TAT AA - 1 O T				
Constituent		Date	e	
	09/09/93	08/31/94	01/26/95	04/27/95
Benzene	BDL	BDL	BDL	\mathtt{BDL}
Toluene	\mathtt{BDL}	BDL	BDL	\mathtt{BDL}
Ethylbenzene	BDL	BDL.	BDL	\mathtt{BDL}
Xylenes	NA	\mathtt{BDL}	BDL	\mathtt{BDL}
MTBE	BDL	NA	NA	NA
EDB	BDL	NA	NA	NA
IPE	BDL	NA	NA	NA
Total PAH	\mathtt{BDL}	NA	NA	NA
1,1-Dichloroethane	\mathtt{BDL}	\mathtt{BDL}	BDL	\mathtt{BDL}
Trichloroethene	BDL	BDL	BDL	BDL
cis-,1,2-Dichloroethylene	NA	BDL	\mathtt{BDL}	BDL
Vinyl Chloride	\mathtt{BDL}	BDL	BDL	BDL
Naphthalene	\mathtt{BDL}	BDL	BDL	\mathtt{BDL}
Lead	0.05	NA	NA	NA

MW-17

Constituent	Date			
	09/09/93	08/30/94	01/31/95	04/27/95
Benzene	BDL	BDL	BDL	BDL
Toluene	BDL	\mathtt{BDL}	BDL	BDL
Ethylbenzene	BDL	\mathtt{BDL}	BDL	BDL
Xylenes	NA	BDL	BDL	BDL
MTBE	BDL	NA	NA	NA
EDB	BDL	NA	NA	NA
IPE	\mathtt{BDL}	NA	NA	NA
Total PAH	BDL	NA	NA	NA
1,1-Dichloroethane	17.1	BDL	15.5	23.3
Trichloroethene	BDL	BDL	BDL	BDL
cis-,1,2-Dichloroethylene	NA	BDL	3.8	2.1
Vinyl Chloride	2.2	38.9	63.0	BDL
Naphthalene	BDL	\mathtt{BDL}	BDL	BDL
Lead	0.05	NA	NA	NA

All units in micrograms per liter ($\mu g/l$)

NA - Not Analyzed

BDL - Below Method Detection Limits

Front Royal Project 0013-94-012

Table 4. Summary of Historical Ground Water Analytical Data

MW-18				
Constituent	Date			
	09/09/93	08/30/94	01/31/95	04/27/95
Benzene	\mathtt{BDL}	BDL	\mathtt{BDL}	\mathtt{BDL}
Toluene	1.3	BDL	BDL	\mathtt{BDL}
Ethylbenzene	\mathtt{BDL}	BDL	\mathtt{BDL}	BDL
Xylenes	NA	\mathtt{BDL}	BDL	\mathtt{BDL}
MTBE	\mathtt{BDL}	NA ·	NA	NA
EDB	\mathtt{BDL}	NA	NA	NA
IPE	\mathtt{BDL}	· NA	NA	NA
Total PAH	\mathtt{BDL}	NA	NA	NA
Chloroform	\mathtt{BDL}	BDL	BDL	3.4
1,1-Dichloroethane	48.1	BDL	BDL	97.9
1,2-Dichloroethane	BDL	BDL	27.0	\mathtt{BDL}
1,1-Dichloroethene	BDL	BDL	3.9	\mathtt{BDL}
Trichloroethene	BDL	BDL	BDL	\mathtt{BDL}
cis-,1,2-Dichloroethylene	NA	BDL	4.8	1.4
Vinyl Chloride	10.9	\mathtt{BDL}	50.0	\mathtt{BDL}
Naphthalene	BDL	BDL	\mathtt{BDL}	BDL
Chloroethane	BDL	\mathtt{BDL}	50.0	BDL
Lead	0.05	NA	NA	NA

MW-19

Constituent	Date			
Collidation	09/09/93	08/30/94	01/31/95	04/26/95
Benzene	BDL	BDL	BDL	BDL
Toluene	BDL	BDL	BDL	BDL
Ethylbenzene	BDL	\mathtt{BDL}	BDL	BDL
Xylenes	NA	\mathtt{BDL}	BDL	BDL
MTBE	BDL	NA	NA	NA
EDB	BDL	NA	NA	NA
IPE	BDL	NA	NA	NA
Total PAH	BDL	NA	NA	NA
1,1-Dichloroethane	BDL	\mathtt{BDL}	\mathtt{BDL}	\mathtt{BDL}
Trichloroethene	BDL	\mathtt{BDL}	BDL	BDL
cis-,1,2-Dichloroethylene	NA	\mathtt{BDL}	BDL	BDL
Vinyl Chloride	BDL	BDL	BDL	BDL
Naphthalene	BDL	BDL	BDL	BDL
Lead	0.05	NA	NA	NA

All units in micrograms per liter (µg/l)

NA - Not Analyzed

BDL - Below Method Detection Limits

Front Royal Project 0013-94-012

Table 4. Summary of Historical Ground Water Analytical Data

MW-20S

Constituent	Date			
	09/15/93	08/30/94	01/25/95	04/26/95
Benzene	15.0	64.4	44.0	71.8
Toluene	1.8	9.5	6.2	BDL
Ethylbenzene	BDL	1,638.0	7.0	14.6
Xylenes	NA	21.0	16.7	20.6
MTBE	7.3	NA	NA	NA
EDB	BDL	NA	NA	NA
IPE	14.2	NA	NA	NA
Total PAH	BDL	NA	NA	NA
1,1-Dichloroethane	BDL	BDL	BDL	BDL
Trichloroethene	BDL	BDL	BDL	BDL
cis-,1,2-Dichloroethylene	NA	BDL	BDL	BDL
Vinyl Chloride	\mathtt{BDL}	\mathtt{BDL}	\mathtt{BDL}	BDL
Naphthalene	BDL	3.8	3.3	4.9
Lead	0.05	NA	NA	NA

MW-20D

Constituent	Date			
	09/09/93	08/31/94	01/25/95	04/27/95
Benzene	BDL	30.0	22.0	29.8
Toluene	\mathtt{BDL}	BDL	BDL	\mathtt{BDL}
Ethylbenzene	BDL	BDL	BDL	\mathtt{BDL}
Xylenes	NA	BDL	\mathtt{BDL}	BDL
MTBE	6.2	NA	NA	NA
EDB	\mathtt{BDL}	NA	NA	NA
IPE	\mathtt{BDL}	NA	NA	NA
Total PAH	BDL	NA	NA	NA
1,1-Dichloroethane	BDL	\mathtt{BDL}	BDL	\mathtt{BDL}
Trichloroethene	BDL	BDL	BDL	BDL
cis-,1,2-Dichloroethylene	NA	8.0	BDL	5.2
Vinyl Chloride	BDL	\mathtt{BDL}	BDL	BDL
Naphthalene	BDL	\mathtt{BDL}	BDL	BDL
Lead	0.05	NA	NA	NA

All units in micrograms per liter (µg/l)

NA - Not Analyzed

BDL - Below Method Detection Limits

Front Royal Project 0013-94-012

Table 4. Summary of Historical Ground Water Analytical Data

MW-21

IVI VV ~Z I							
Constituent	Date						
	09/09/93	08/30/94	01/26/95	04/27/95			
Benzene	BDL	30.00	BDL	BDL			
Toluene	\mathtt{BDL}	BDL	BDL	BDL			
Ethylbenzene	\mathtt{BDL}	BDL	BDL	BDL			
Xylenes	NA	BDL	BDL	BDL			
MTBE	\mathtt{BDL}	NA	NA	NA			
EDB	\mathtt{BDL}	NA	NA	NA			
IPE	\mathtt{BDL}	NA	NA	NA			
Total PAH	\mathtt{BDL}	NA	NA	NA			
1,1-Dichloroethane	BDL	BDL	BDL	BDL			
Trichloroethene	\mathtt{BDL}	\mathtt{BDL}	BDL	BDL			
cis-,1,2-Dichloroethylene	NA	BDL	BDL	BDL			
Vinyl Chloride	BDL	BDL ·	BDL	BDL			
Naphthalene	BDL	BDL	BDL	BDL			
Lead	0.05	NA	NA	NA			

MW-22

IVI VY -22								
Constituent	Date							
	04/28/94	08/30/94	01/26/95	04/27/95				
Benzene	9.4	BDL	BDL	BDL				
Toluene	NA	BDL	BDL	BDL				
Ethylbenzene	NA	BDL	BDL	BDL				
Xylenes	NA	BDL	BDL	BDL				
MTBE	BDL	NA	NA	NA				
EDB	\mathtt{BDL}	NA	NA	NA				
IPE	8.0	NA	NA	NA				
Total PAH	BDL	NA	NA	NA				
1,1-Dichloroethane	NA	BDL	BDL	BDL				
Trichloroethene	NA	BDL	BDL	BDL				
cis-,1,2-Dichloroethylene	NA	BDL	BDL	BDL				
Vinyl Chloride	NA	\mathtt{BDL}	BDL	BDL				
Naphthalene	NA	BDL	BDL	BDL				
Lead	BDL	NA	NA	NA				

All units in micrograms per liter (µg/l)

NA - Not Analyzed

BDL - Below Method Detection Limits

Front Royal Project 0013-94-012

139412-4.wk4

MW-23

MW-23								
Constituent	Date							
	04/28/94	08/30/94	01/26/95	04/26/95				
Benzene	21.0	68.4	36.0	67.9				
Toluene	NA	13.0	\mathtt{BDL}	14.5				
Ethylbenzene	NA	46.5	14.0	40.4				
Xylenes	NA	100.0	40.0	95.3				
MTBE	BDL	NA	NA	NA				
EDB	BDL	NA	NA	NA				
IPE	15.0	NA	NA	NA				
Total PAH	8.0	NA	NA	NA				
1,1-Dichloroethane	NA	BDL	BDL	BDL				
Trichloroethene	NA	BDL	\mathtt{BDL}	BDL				
cis-,1,2-Dichloroethylene	NA	BDL	BDL	BDL				
Vinyl Chloride	NA	\mathtt{BDL}	\mathtt{BDL}	BDL				
Naphthalene	NA	33.7	42.5	42.9				
Lead	\mathtt{BDL}	NA	NA	NA				

MW-24

Constituent	Date					
Constituoni	04/28/94	08/30/94	01/31/95	04/27/95		
Benzene	BDL	BDL	BDL	BDL		
Toluene	NA	BDL	BDL	BDL		
Ethylbenzene	NA	\mathtt{BDL}	BDL	BDL		
Xylenes	NA	\mathtt{BDL}	BDL	\mathtt{BDL}		
MTBE	BDL	NA	NA	NA		
EDB	BDL	NA	NA	NA		
IPE	\mathtt{BDL}	NA _.	NA	NA		
Total PAH	BDL	NA	NA	NA		
1,1-Dichloroethane	NA	BDL	BDL	BDL		
Trichloroethene	NA	BDL	BDL	BDL		
cis-,1,2-Dichloroethylene	NA	\mathtt{BDL}	BDL	BDL		
Vinyl Chloride	NA	\mathtt{BDL}	BDL	BDL		
Naphthalene	NA	\mathtt{BDL}	BDL	BDL		
Lead	BDL	NA	NA	<u>NA</u>		

All units in micrograms per liter (μ g/l)

NA - Not Analyzed

BDL - Below Method Detection Limits

Front Royal Project 0013-94-012

139412-4.wk4

Table 4. Summary of Historical Ground Water Analytical Data

MW-25

MW-25			
Constituent		Date	
	08/30/94	01/31/95	04/27/95
Benzene	BDL	\mathtt{BDL}	\mathtt{BDL}
Toluene	BDL	\mathtt{BDL}	\mathtt{BDL}
Ethylbenzene	\mathtt{BDL}	\mathtt{BDL}	\mathtt{BDL}
Xylenes	BDL	\mathtt{BDL}	\mathtt{BDL}
MTBE	NA	NA	NA
EDB	NA	NA	NA
IPE	NA	NA	NA
Total PAH	NA	NA	NA
Chloroform	BDL	BDL	102.0
1,1-Dichloroethane	840.0	690.0	632.0
1,2-Dichloroethane	\mathtt{BDL}	BDL	BDL
1,1-Dichloroethene	BDL	770.0	708.0
Trichloroethene	280.0	125.0	267.0
1,1,1-Trichloroethane	\mathtt{BDL}	1,710.0	2,709.0
cis-,1,2-Dichloroethylene	330.0	470.0	319.0
Vinyl Chloride	BDL	\mathtt{BDL}	BDL
Naphthalene	BDL	BDL	2.2
Lead	NA	NA	NA

MW-26

Constituent		Date	
	08/29/94	01/26/95	04/27/95
Benzene	\mathtt{BDL}	BDL	BDL
Toluene	BDL	BDL	BDL
Ethylbenzene	\mathtt{BDL}	BDL	BDL
Xylenes	BDL	BDL	BDL
MTBE	NA	NA	NA
EDB	NA	NA	NA
IPE	NA	NA	NA
Total PAH	NA	NA	NA
1,1-Dichloroethane	BDL	100.0	109.0
1,1-Dichloroethene	BDL	BDL	8.1
Trichloroethene	BDL	BDL	BDL
cis-,1,2-Dichloroethylene	BDL	BDL	4.9
Vinyl Chloride	29.5	BDL	BDL
Naphthalene	BDL	42.5	BDL
Lead	NA	NA	NA

All units in micrograms per liter (μ g/l)

NA - Not Analyzed

BDL - Below Method Detection Limits

Front Royal Project 0013-94-012

139412-4.wk4

Table 5. Physical and Chemical Properties of Selected Gasoline Constituents*

	Log Octanol/Water Partition Coefficient	Water Solubility (mg/L)	Specific Gravity	Vapor Pressure (mm Hg)	Henry's Law Constant (atm-m3/mole)
Benzene Toluene Ethylbenzene Xylenes	2.13 ; 2.73 ; 3.15 ; 3.12	1,791.0 534.8 161.0 175.0	0.88 0.87 1.87 0.88	95.19 28.40 9.53 6.60	0.00543 0.00594 0.00844 0.00510
1,1,1 Trichloroethane Trichloroethene 1,1 Dichloroethane Naphthalene Vinyl Chloride	2.47 2.53 1.79 3.37 0.60	4,400.0 1,100.0 5,500.0 30.0 1.1	NA NA NA NA	100.00 77.00 234.00 0.08 2580.00	0.00408 0.00117 0.00545 0.00048 0.00278

mg/L - milligrams per liter

mm Hg - millimeters of Mercury

atm-m3/mole - atmosphere-cubic meters per mole

NA - Not Available

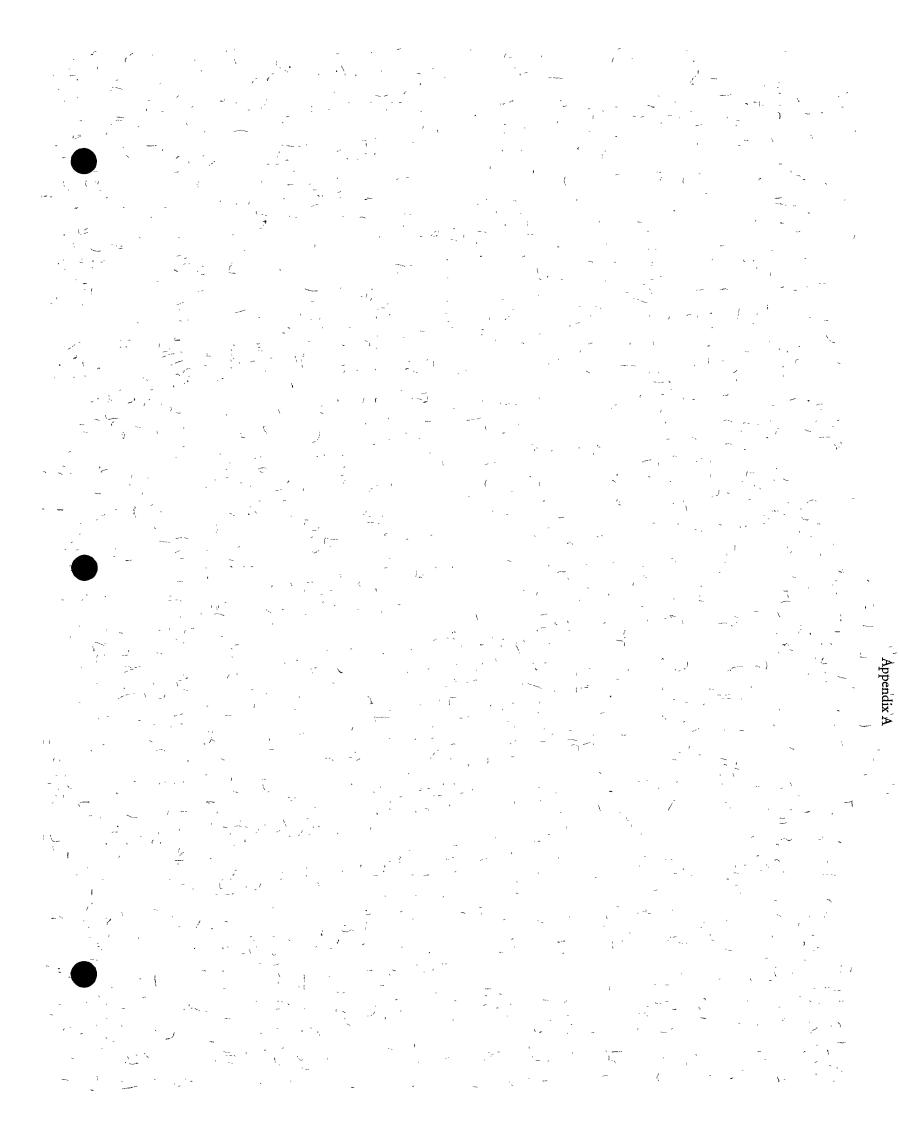
Front Royal Project Number 0013-94-012 139412-5.wk4

^{* -} Howard, 1989

Table 6. Water Supply Well Locations

Owner/Resident	Address
Aron	4807 Denfield Street
Wright	4811 Denfield Street
Mr. Lawrance Morrison	4901 Denfield Street
Church of Prophecy	4907 Denfield Street
H.T. Pendergrass/Walters	4911 Denfield Street
W.T. Proctor Grading Contractors owner: Ms. Carolyn Bass	4918 Denfield Street
Mr. Albert Deer	4921 Denfield Street
Mayo Farms, Inc. manager: Mr. Johnny Talley	4934 Denfield Street
Lee's Welding & Steel Service, Inc.	1002 Communications Drive
Mobile Communications Service, Inc. owner: Ms. JoAnn Harris	1003 Communications Drive
D.W. Ward Construction owner: Mr. Don Ward	1006 Communications Drive

Front Royal Project No. 0013-94-012 139412-6.wk4



Final Report

on

Ground-penetrating Radar Survey at Nello Teer Quarry, Durham, NC

Submitted to

Front Royal Environmental Services, Inc. P.O. Box 4350 Cary, NC 27519

from

Geophex, Ltd. 605 Mercury Street Raleigh, NC 27603-2343 Telephone (919) 839-8515 Fax (919) 839-8528

Geophex Job Number 468 January 1995





January 9, 1995

..)

Ms. Stephanie Freise Front Royal Environmental Services, Inc. P.O. Box 4350 Cary, North Carolina 27519

Subject: Ground-penetrating Radar Survey at Nello Teer Quarry, Durham, NC. Purchase Order 41535 dated 11/8/94, Geophex Job No. 468.

Dear Ms. Freise:

Attached is the report for the geophysical survey activities conducted on November 15 and 16, 1994 at the subject site. If you have any further comments or questions, please feel free to contact me at your convenience.

Sincerely,

David W.A. Taylor, PhD Special Programs Manager

Final Report

on

Ground-penetrating Radar Survey at Nello Teer Quarry, Durham, NC

Submitted to

Front Royal Environmental Services, Inc. P.O. Box 4350 Cary, NC 27519

from

Geophex, Ltd. 605 Mercury Street Raleigh, NC 27603-2343 Telephone (919) 839-8515 Fax (919) 839-8528

Geophex Job Number 468 January 1995

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3.0 Results and interpretations	
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1.0 Project Introduction

This report describes the results of the ground-penetrating radar (GPR) survey conducted at the Nello Teer Quarry in Durham, Durham County, NC. The Nello Teer Quarry is mined for diabase gravel. The purpose of the investigation was to conduct a geophysical survey to determine locations of buried deposits of tar, asphalt, or other similar material in the upper 10 feet of soil. Geophex personnel conducted a GPR survey on November 15 and 16 of a 260 foot by 300 foot area at the Nello Teer Quarry, as directed by Mr. Christian Reinhardt of Front Royal Environmental Services (Figure 1). The site consists of fill material with several concrete pads and large piles of gravel at the edge of the southern wall of the quarry.

2.0 Methods and Procedures

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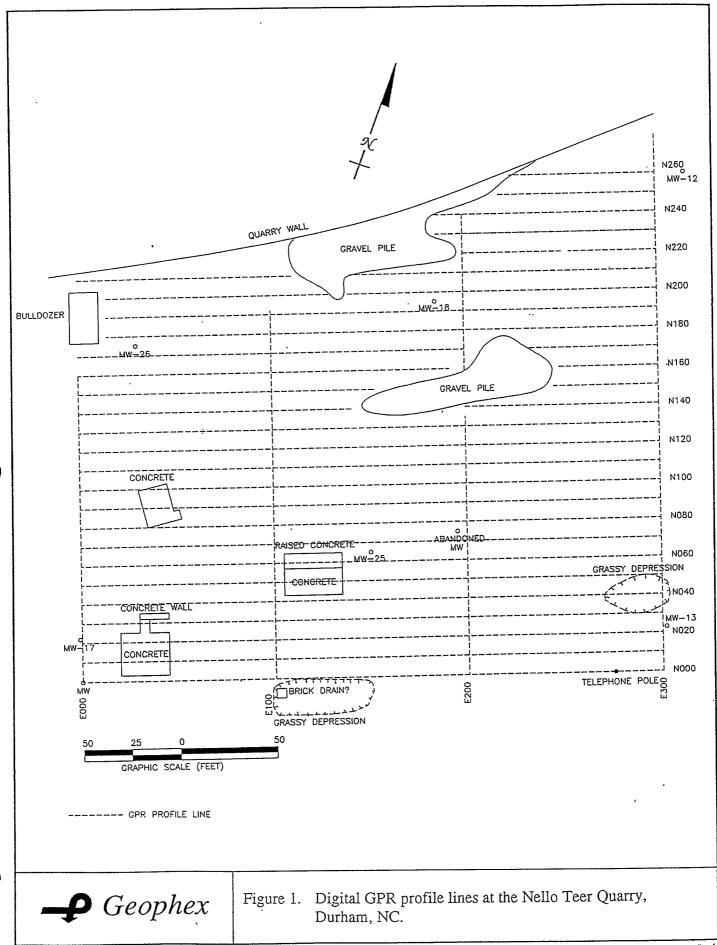
We collected 27 east-west and four north-south GPR profile lines using our pulseEKKO IV digital bistatic (i.e., transmitter and receiver separate) GPR system manufactured by Sensors and Software, Inc. (serial number 901103). Using digital control, antenna-mounted triggering, analog to digital conversion, and fiber optic communications between the antennas and the control unit, the pulseEKKO IV generates an electromagnetic pulse with a preset 100 MHz centered frequency antenna. We collected the data at three-foot intervals along the profile lines. The east-west profile lines were ten feet apart, and the north-south profiles were 100 feet apart.

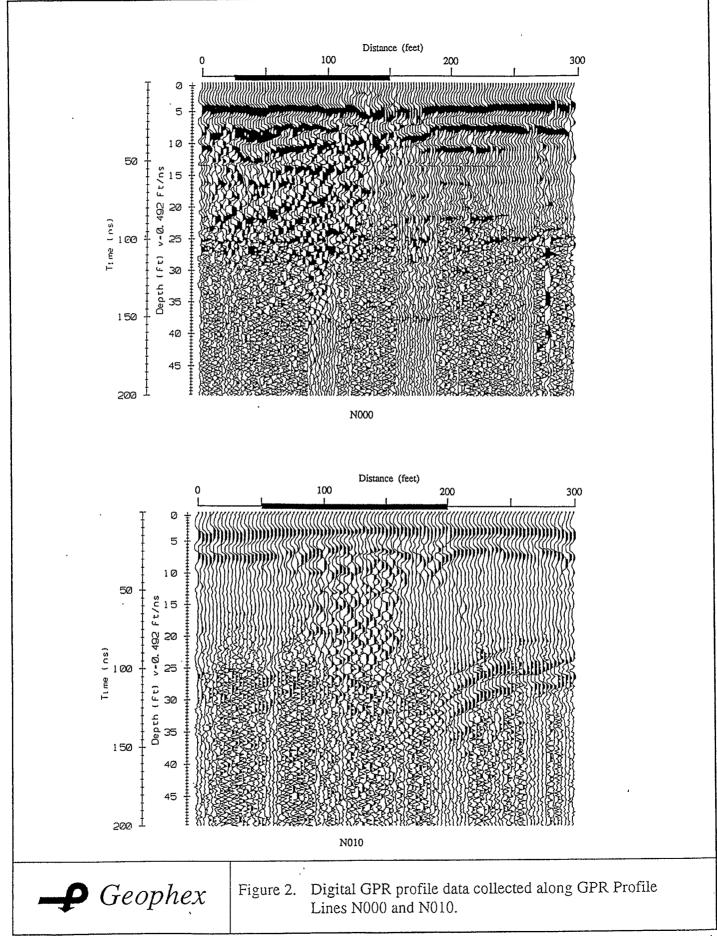
We recorded the data on a computer in the field. We plotted the data using the pulseEKKO IV program in the office. We did not use a terrain correction or any other special filtering techniques. Our interpretations are based on the raw data that we collected. We calculated an approximate depth for each profile using an estimated material velocity of 0.492 ft/ns.

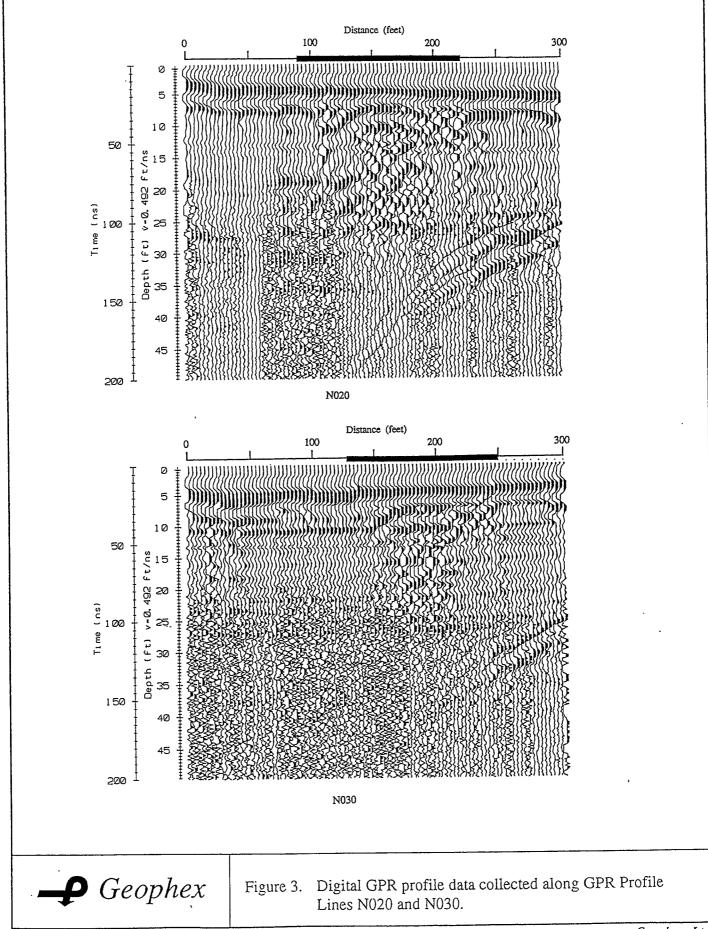
3.0 Results and Interpretations

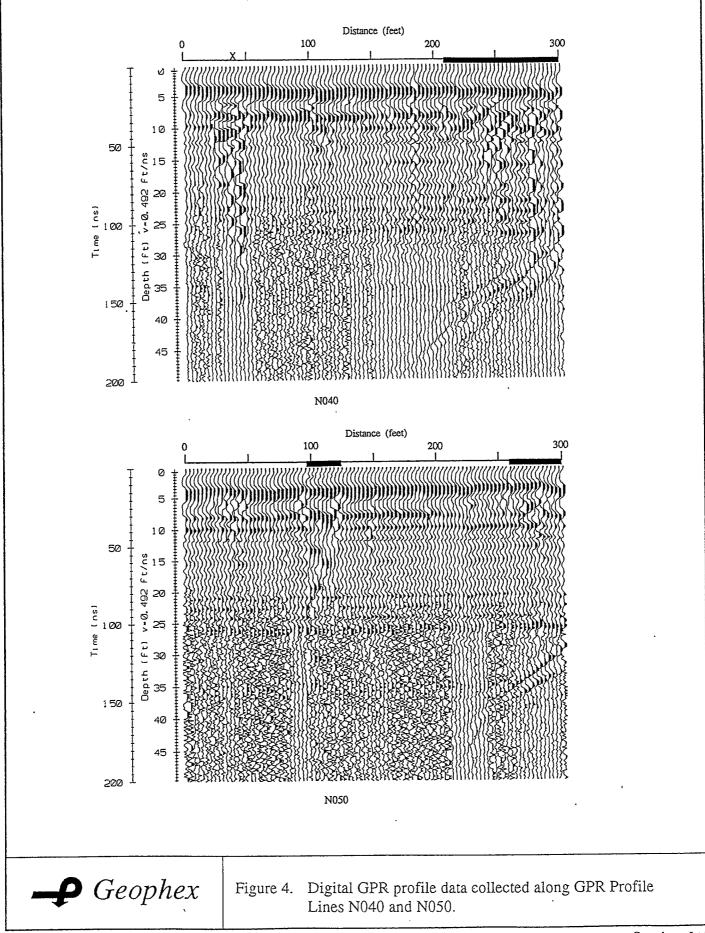
Figures 2 through 17 show the GPR profile data looking north on the east-west profiles and looking west on the north-south profiles. Each profile has both time in nanoseconds (ns) and approximate depth in feet (ft) as vertical scales. We identified four anomalous regions (Figure 18) on each GPR profile and plotted their locations on the base map. The anomalies are identified on Figures 2 through 17 with a bold line. Without additional information, we are unable to determine the source of these anomalies.

We also identified the interpreted locations of metal objects based on the GPR data. Their locations are identified on Figures 2 through 18 with an "X". The identification of several metal objects with GPR indicates the likely presence of additional metal objects within the site.

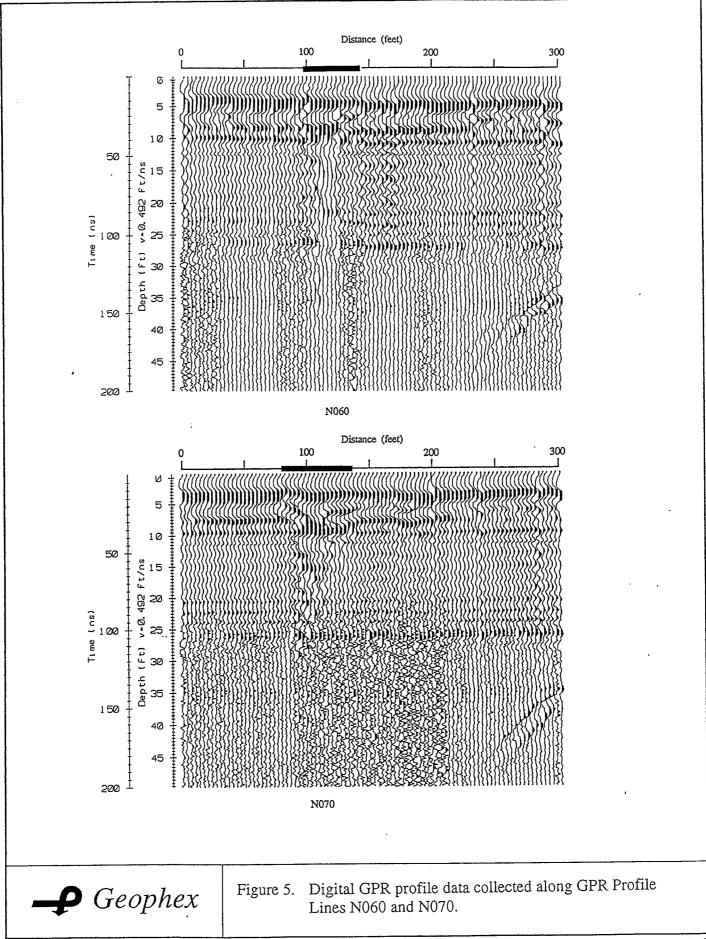




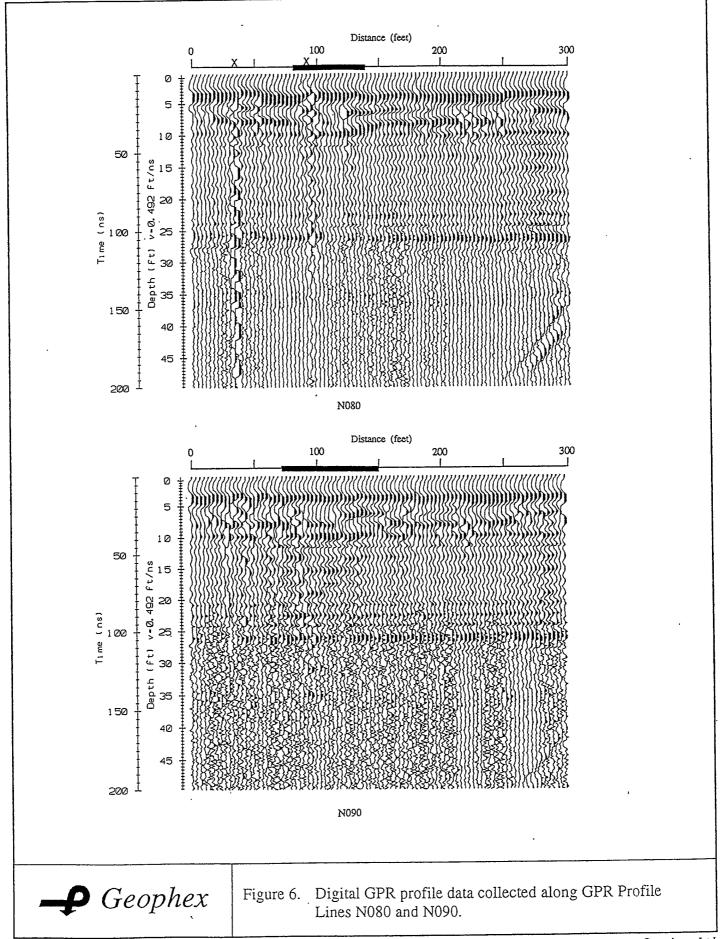


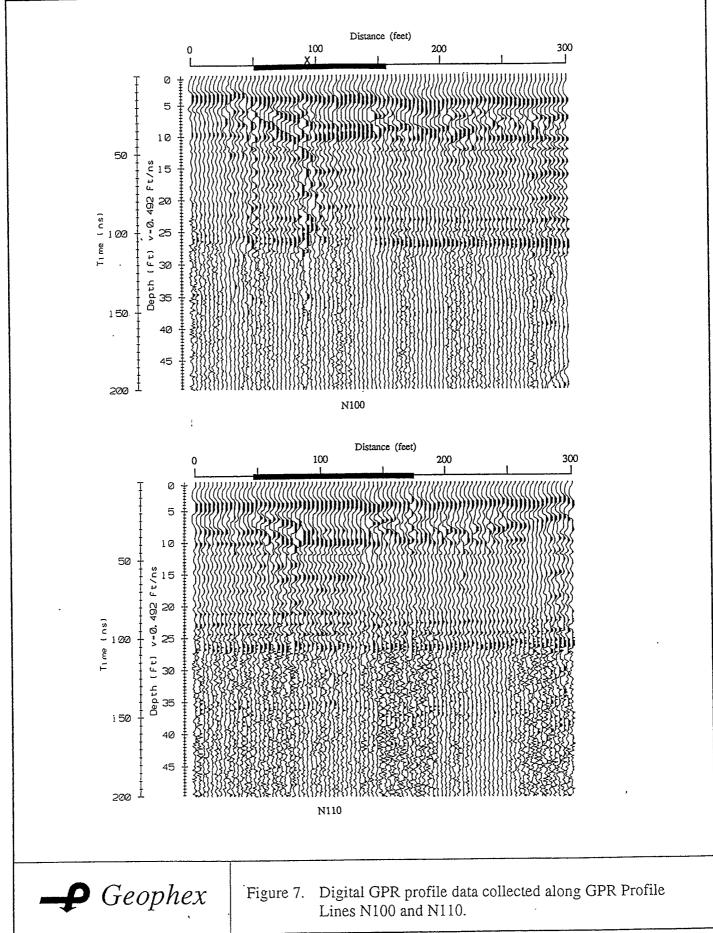


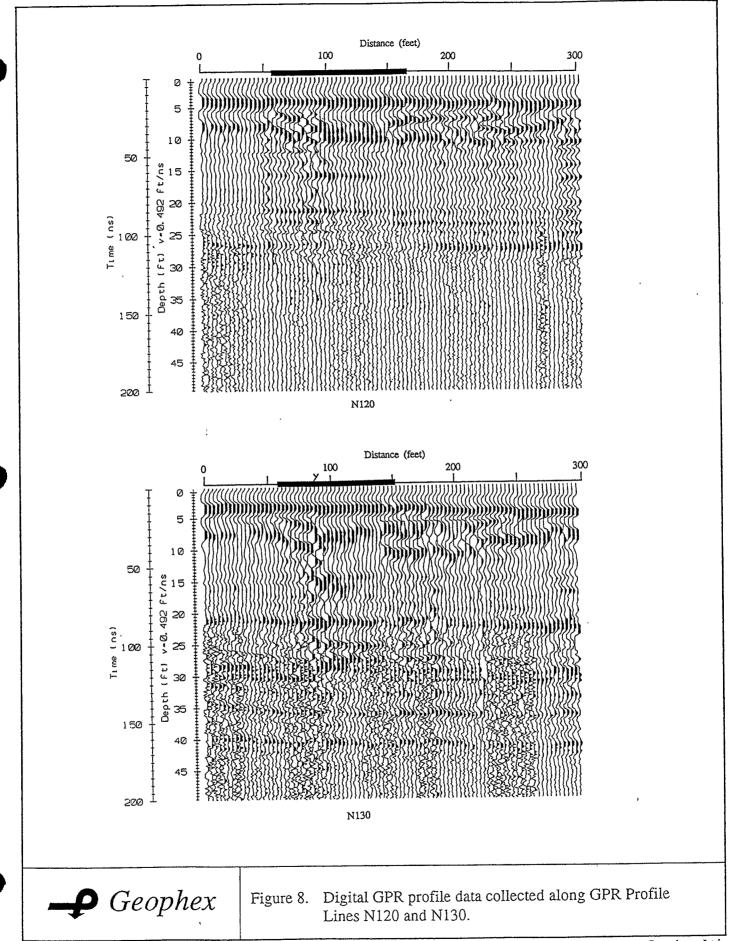
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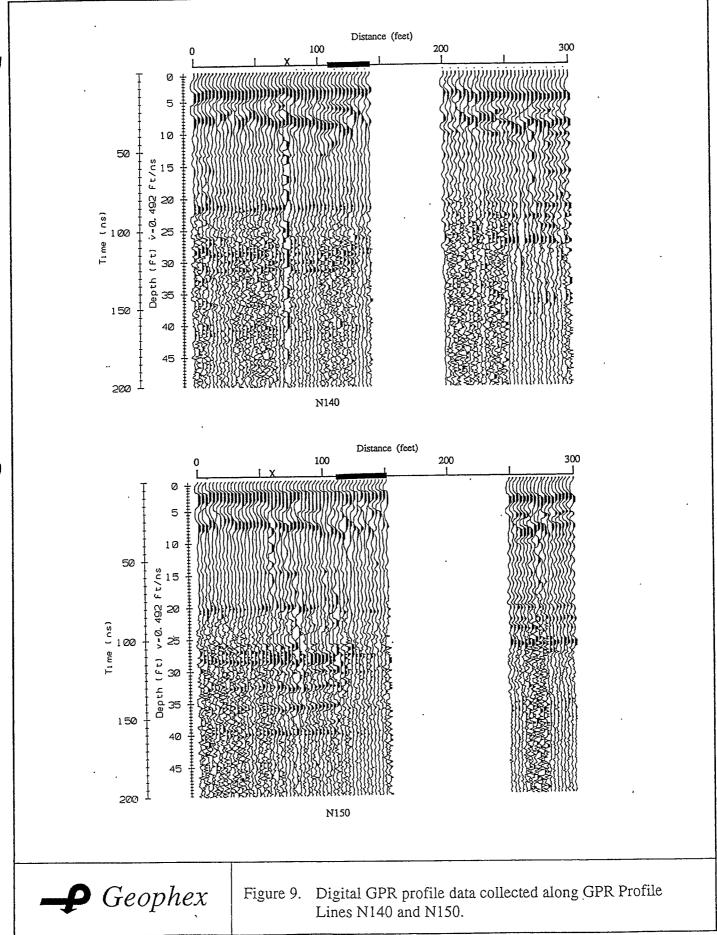
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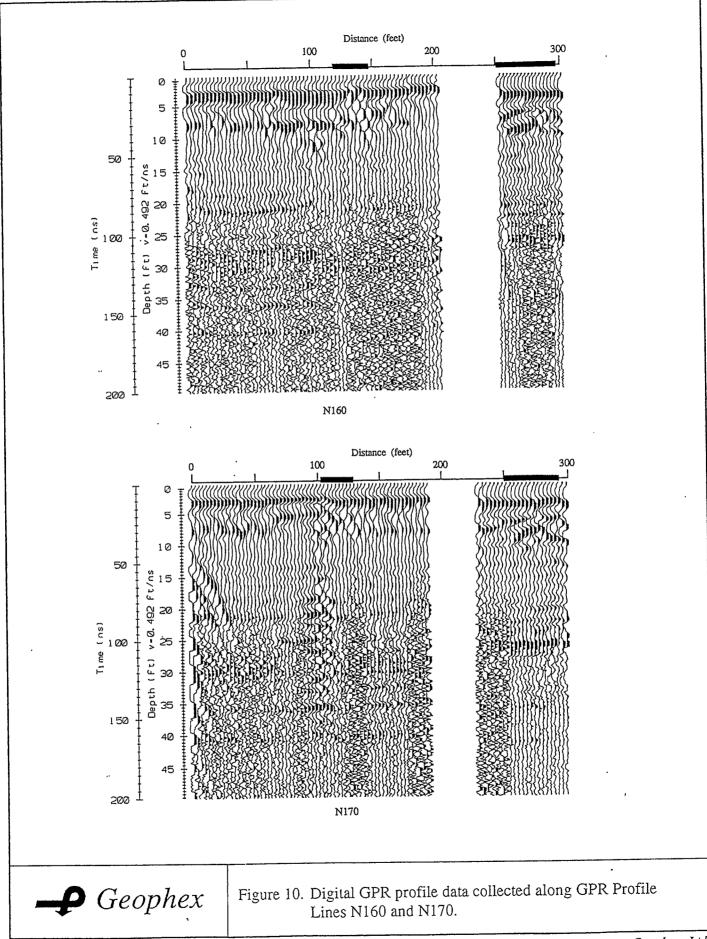




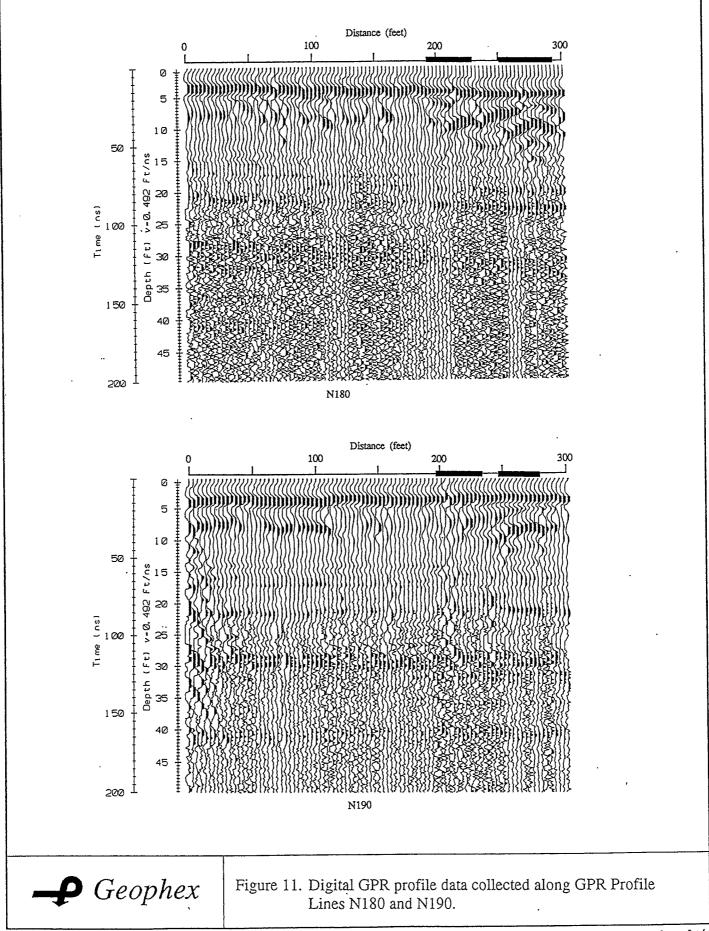


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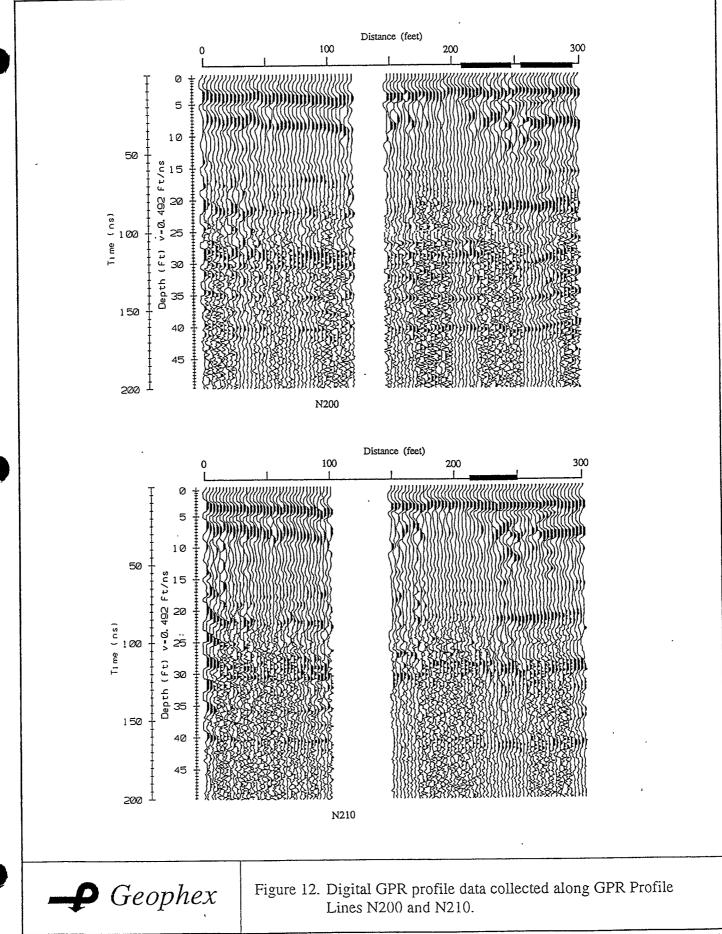


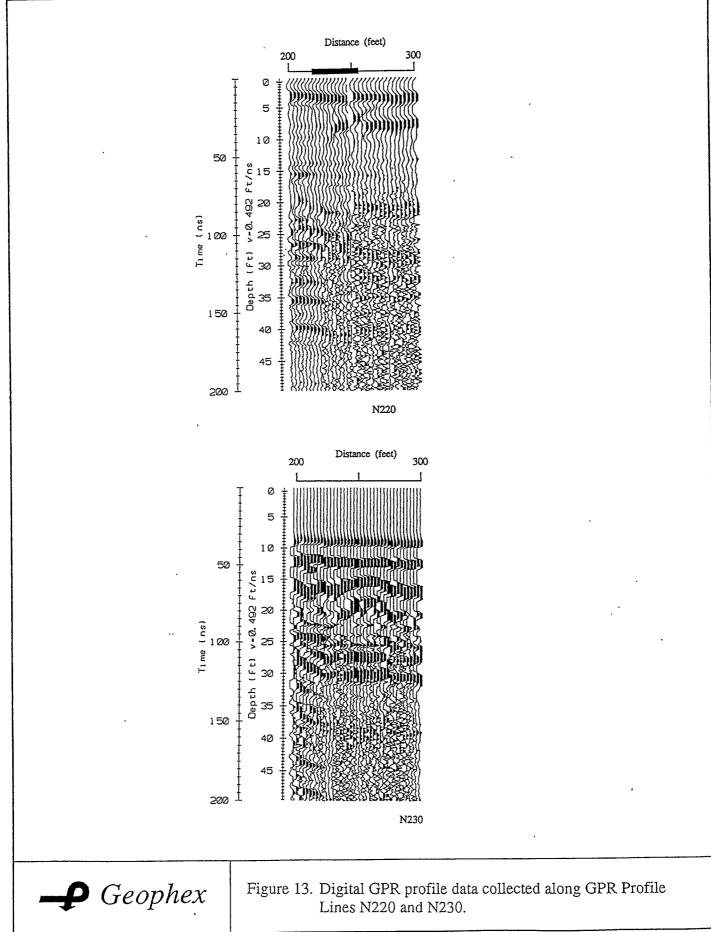
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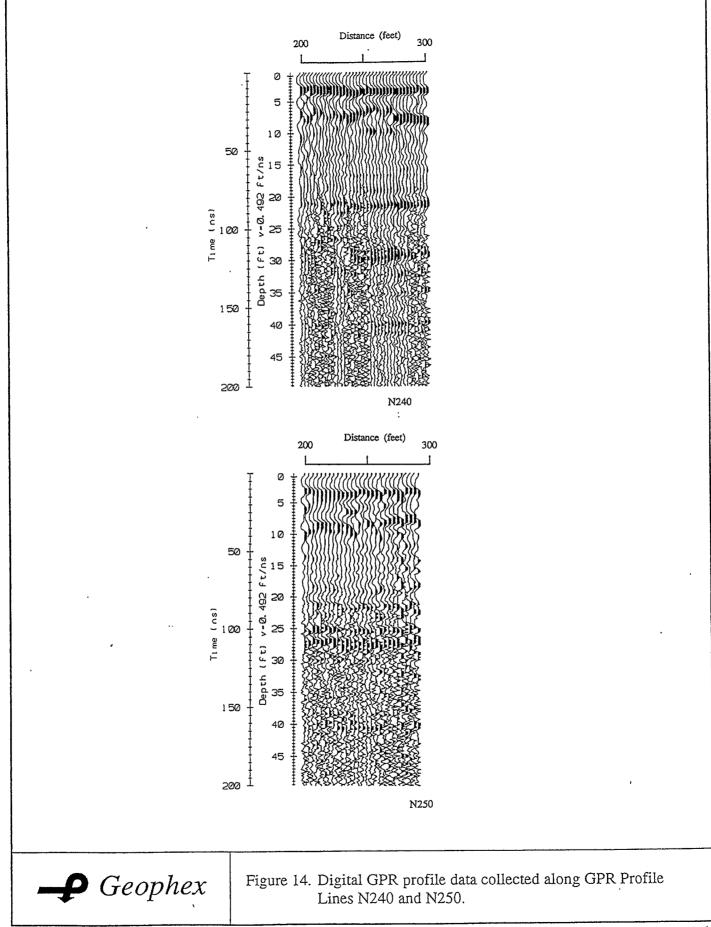
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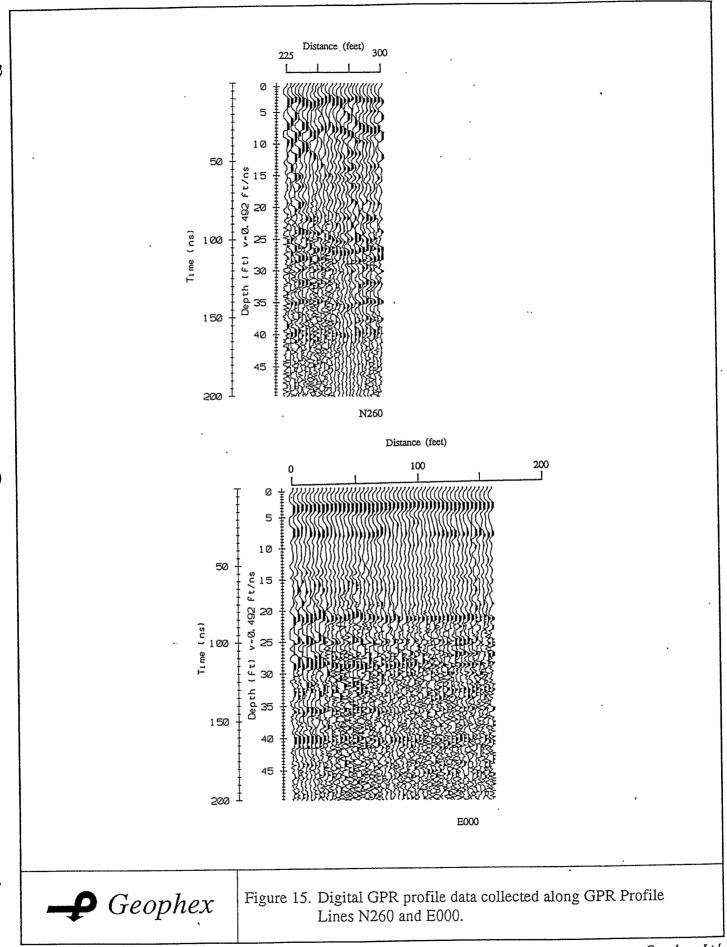




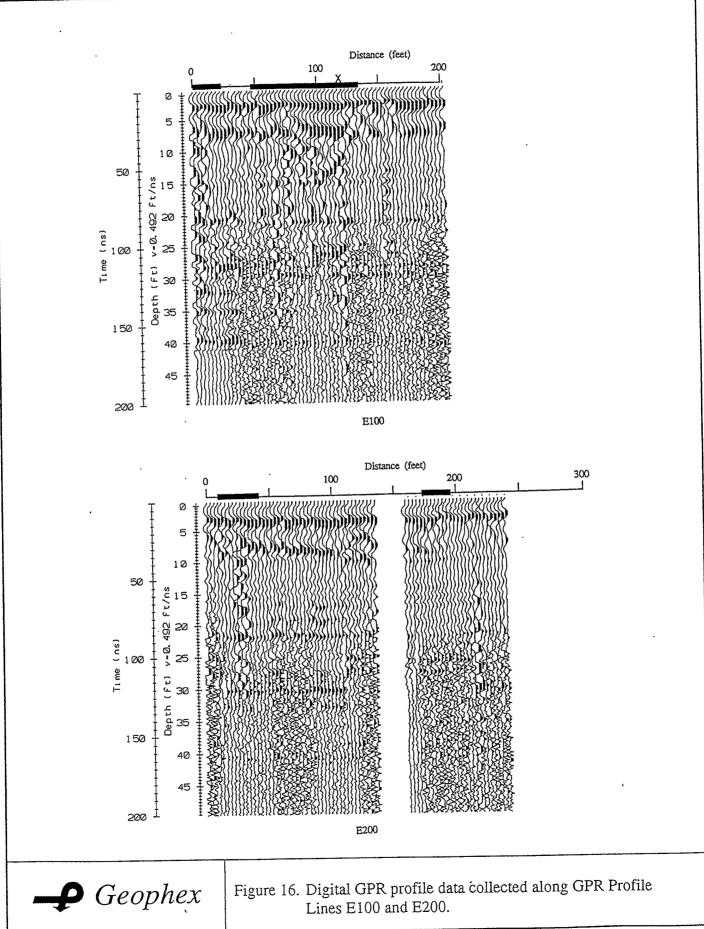
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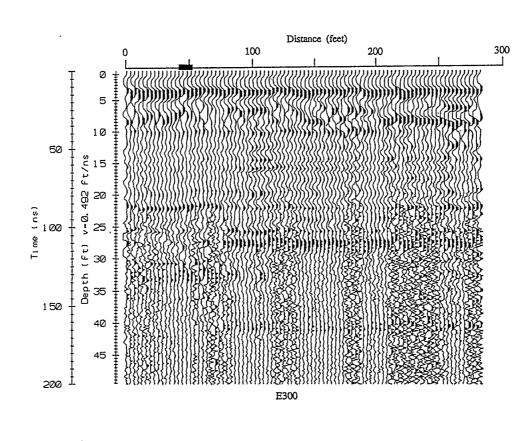




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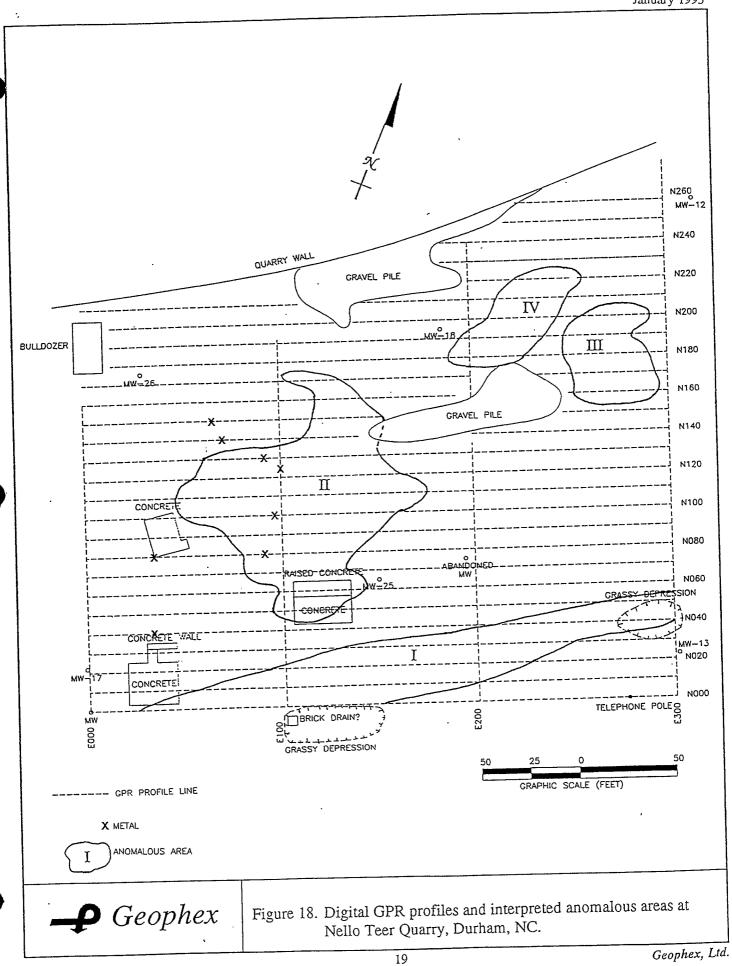
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Figure 17. Digital GPR profile data collected along GPR Profile Line E300.



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July 27, 1995

REPORTING:

Hydrologic Morris., Inc. 2500 Gateway Centre Suite #900 Morrisville, NC 27560

Attention: Pomercy Smith

PROJECT NUMBER: FL9512070

DATE COMPLETED: July 27, 1995 DATE RECEIVED: July 18, 1995

INVOICING:

HydroLogic-Morris., Inc. 2500 Gateway Centre Suite #900 Morrisville, NC 27560

PROJECT DESCRIPTION:

Front Royal Env./#0013-94-016-1 soil sample analyzed for 3550/5030/9071/TCLP(8240/8270).

Enclosed is the laboratory report for the project described above. If you have any questions or if we can be of further assistance, please feel free to contact Jamie Fore. We appreciate your business and look forward to serving you again soon.

Respectfully,

Benjamin Carl Esterie

Laboratory Director

Post-it* Fax Note 7671	Date 7-28 # of pages ▶ 7
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Co. Dept. Fort Coupl	Co.
Phone #	Phone #
Fax #	Fax#
	1

HYDROLOGIC, INC

COMPANY NAME: COMPANY PROJECT NUMBER: Hydrologic-Morris., Inc. FRONT ROYAL ENV./#013-94-016

HYDROLOGIC PROJECT NUMBER:
HYDROLOGIC SAMPLE NUMBER:
HYDROLOGIC LAB I.D. #:
SAMPLE IDENTIFICATION:
DATE SAMPLED:
DATE EXTRACTED:

9512070 399 COMP A 7/17/95

FI9512070

DATE/TIME ANALYZED:

7/20/95 7/25/95 7/25/95

METROD TPH 3550/5030

ANALYSIS CAS NO.	(mg/kg)	RESULT (mg/kg)	
Diesel		2.1	149
Gasoline		2.0	HOL

HDL = Below Sample Detection Limit SDL = Sample Detection Limit

COMMENUS: DIESEL: DILUTION FACTOR X 2

HYDROLOGIC, INC

COMPANY NAME: COMPANY PROJECT NUMBER: Hydrologic-Morris., Inc. FRONT ROYAL ENV./\$013-94-016

HYDROLOGIC PROJECT NUMBER:
HYDROLOGIC SAMPLE NUMBER:
HYDROLOGIC LAB I.D. #:
SAMPLE IDENTIFICATION:
DATE SAMPLED:

FI.9512070 9512070 399 COMP A 7/17/95 7/18/95 7/26/95

DATE SAMPLED:
DATE EXTRACTED:
DATE/TIME ANALYZED:

METROD TCIP 8240

ANALYSIS	CAS NO.	<u>SDL</u> (mg/L)	RESULT (mg/L)
Benzena	71-43-2	0.001	BOL
Carbon Tetrachloride	5 6-23-5	0.001	BDL
Chlorobenzene	108 -90- 7	0.001	BDL
Chloroform	67-66-3	0.001	BDL
1,4-Dichlorobenzene	106-46-7	0.001	BDL
1,2-Dichloroethane	107-06 - 2	0.001	BDL
1,1-Dichloroethene	75-35-4	0.001	BDL
2-Butanone	78-93-3	0.100	BOL
Tetrachloroethene	127-18-4	0.001	\mathbf{BDL}
Trichloroethene	79-01-6	0.001	BDL
Vinyl Chloride	75-01-4	0.005	BDL BDL
Surrogate Recoveries: 1,2-Dichloroethane-D4 Toluene-D8 Bromofluorobenzene			96% 114% 120%

BDL	=	Below	Sample	Dete	ection	Limit
			Detect			

1491 Twilight Trail	☐ Frankfort, KY	40601	☐ 502/223-0251	FAX 502/875-8016 Toll Free 1-800/728-2251

COMMENTS:

HYDROLOGIC, INC

COMPANY NAME: COMPANY PROJECT NUMBER: Hydrologic-Morris., Inc. FRONT ROYAL ENV./#013-94-016

HYDROLOGIC PROJECT NUMBER:
HYDROLOGIC SAMPLE NUMBER:
HYDROLOGIC LAB I.D. #:
SAMPLE IDENTIFICATION:
DATE SAMPLED:
DATE EXTRACTED:
DATE/TIME ANALYZED:

FI.9512070 9512070 399 COMP A 7/17/95 7/18/95 7/25/95

METHOD TCLP 8270

<u>ANALYSIS</u>	CAS NO.	<u>sm.</u> (mg/l)	RESULT (mg/l)
1,4-Dichlorobenzene 2-Methylphenol 3-Methylphenol 4-Methylphenol Hexachloroethane	106-46-7 95-48-7 108-39-4 106-44-5 67-72-1	0.05 0.05 0.05 0.05 0.05	BDL RDL BDL BDL BDL
Nitrobenzene Hexachlorobutadiene 2,4,6-Trichlorophenol 2,4,5-Trichlorophenol 2,4-Dinitrotoluene	98 - 95-3 87-68-3 88-06-2 95 - 95-4 121-14-2	0.05 0.05 0.05 0.05 0.05	HOL HOL HOL HOL
Hexachlorobenzene Pentachlorophenol Pyridine	118-74-1 87-86-5 110-86-1	0.05 0.05 0.25	BDL BDL BDL
Surrogate Recoveries: 2-Fluorophenol Phenol-D6 Nitrobenzene-D5 2-Fluorobiphenyl 2,4,6-Tribromophenol Terphenyl-D14			98% 82% 96% 96% 60% 108%

BDL = Below Sample Detection Limit SDL = Sample Detection Limit	

1491 Twilight Trail	☐ Frankfort, KY 4	0601 🗆 502/223-025	1 🔲 FAX 502/875-8016	☐ Toll Free 1-800/728-2251

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COMPANY NAME:

HydroLogic-Morris., Inc.

COMPANY PROJECT NUMBER:

FRONT ROYAL ENV. /#013-94-016

HYDROLOGIC PROJECT NUMBER; HYDROLOGIC SAMPLE NUMBER:

FL9512070 9512070

HYDROLOGIC LAB I.D. #: SAMPLE IDENTIFICATION: 399 COMP A

DATE SAMPLED:

7/17/95

DATE/TIME ANALYZED

METHOD UNITS SDL RESULT

Oil and Grease

ANALYSIS

7/20/95

mg/kg TPH 9071

10

1437

BDL = Below Sample Detection Limit SDL = Sample Detection Limit

COMMENTS:		
1491 Twilight Tr	ail Srankfort, KY 40601 S02/223-0251 SAX 502/875-8016 Toll Free 1-800/728-	2251

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Date Shipped:	7/12/94		Project N		~ -		Suite 900 Horrisville, NC 27
Comments:				_		4-016	
Commence			P.O. #:	-	980		800-241-4174 919-380-9717 (Fax)
one sample per li	INE			SAMPLE	TYPE		
SAMPLE #	SAMPLE MATRIX	COMP GRAE	DATE	TIME GW	WW WG	SLD OTHER	ANALYSIS & METHOD
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CHAIN OF CUSTODY PO# REPORT TO: FRONT ROYAL FAU. SUCS HydroLogic, Inc. Method of Shipment BRVAN ATTN 2500 Gateway Centre Blvd., Suite 900 Morrisville, NC 27560 800-241-4174 952646 919-380-9699 PAGE BANALYSES PROJECT ID #: CLIENT: NELLO TEER DULHAM QUALLY REPORT DUE: PHONE: 469-9795 HARD COPY PROJ #: 0013-44-012 PO# 41986 FAX COPY VERBAL 5030 SAMPLER: DATE COLLECTED SAMPLE MATRIX TIME REMARKS FIELD ID 7.17.95 11:00 am SOIL COMP A RECEIVED BY: 1:15 DATE / TIME: 4/12/05 DATE / TIME: RELINQUISHED BY: marz DATE / TIME: RECEIVED BY: RELINQUISHED BY: DATE / TIME:

DATE / TIME:

DATE / TIME:

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DATE / TIME:

DATE / TIME:

TOTAL P.815

RELINQUISHED BY:

DISPATCHED BY:

July 25, 1995

REPORTING:

HydroLogic Morris., Inc. 2500 Gateway Centre Suite #900 Morrisville, NC 27560

Attention: Pomeroy Smith

PROJECT NUMBER: FL9512070B

DATE COMPLETED: July 25, 1995 July 18, 1995 DATE RECEIVED:

INVOICING:

HydroLogic Morris., Inc. 2500 Gateway Centre Suite #900 Morrisville, NC 27560

PROJECT DESCRIPTION:

Front Royal Env./#0013-94-016-1 soil sample analyzed for 8240/8270.

Enclosed is the laboratory report for the project described above. If you have any questions or if we can be of further assistance, please feel free to contact Jamie Fore. We appreciate your business and look forward to serving you again soon.

Respectfully,

Benjamin Carl Este Laboratory Director

Date 1/25 Post-It* Fax Note 7671 From Christina Co. house Phone # 1NF-52-1332 10:14

1491 Twilight Trail Frankfort, KY 40601 1 50 21/TA:4 7179 085 919

HYDROLOGIC-MORRISUILLE

HYDROLOGIC, INC.

COMPANY NAME: COMPANY PROJECT NUMBER: HydroLogic Morris., Inc. FRONT ROYAL ENV./#0013-94-016

HYDROLOGIC PROJECT NUMBER: HYDROLOGIC SAMPLE NUMBER: HYDROLOGIC LAB I.D. #: SAMPLE IDENTIFICATION: FI.9512070B 9512070B 399 COMP A 7/17/95 N/A 7/21/95

DATE SAMPLED:
DATE EXTRACTED:
DATE/TIME ANALYZED:

METHOD SW 846 8240

ANALYSIS	CAS NO.	<u>SDL</u> (mg/kg)	RESULT (mg/kg)
Acetone Acrolein Acrylonitrile Benzene Bromodichloromethane	67-64-1 107-02-8 107-13-1 71-43-2 75-27-4	0.200 0.050 0.050 0.005 0.005	BOL BOL BOL BOL
Bromoform Bromomsthane 2-Butanone Carbon Disulfide Carbon Tetrachloride	75-25-2 74-83-9 78-93-3 75-15-0 56-23-5	0.005 0.01 0.100 0.005 0.005	BDL BDL BDL BDL BDL
Chlorobenzene Chloroethane 2-Chloro Ethyl Vinyl Ether Chloroform Chloromethane	108-90-7 75-00-3 110-75-8 67-66-3 74-87-3	0.005 0.01 0.01 0.005 0.01	BOL BOL BOL BOL BOL
Dibromochloromethane Dibromethane 1,4-Dichloro-2-Butane Dichlorodifluoromethane 1,2-Dichlorobenzene	124-48-1 74-95-3 75-71-8 95-50-1	0.005 0.005 0.005 0.01 0.005	BOL BOL BOL BOL
1,3-Dichlorobenzene 1,4-Dichlorobenzene 1,1-Dichloroethane 1,2-Dichloroethane 1,1-Dichloroethene	541-73-1 106-46-7 75-34-3 107-06-2 75-35-4	0.005 0.005 0.005 0.005 0.005	BDL BDL BDL BDL

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Page 2 continued

COMPANY NAME: COMPANY PROJECT NUMBER: HydroLogic-Morris., Inc. FRONT ROYAL ENV./#0013-94-016

HYDROLOGIC PROJECT NUMBER: HYDROLOGIC SAMPLE NUMBER: SAMPLE IDENTIFICATION:

F19512070B 9512070B COMP A 7/17/95

DATE SAMPLED:

METHOD SN 846 8240

anatysis	CAS NO.	(m3/k3) <u>2pr</u>	resuli (mg/kg)
trans-1,2-Dichloroethere 1,2-Dichloropropane cis-1,3-Dichloropropene trans-1,3-Dichloropropene Ethanol	156-60-5 78-87-5 10061-01-5 10061-02-6 64-17-5	0.005 0.005 0.005 0.005 0.100	BOL BOL BOL BOL
Ethylbenzene Ethyl Methacrylate 2-Hexanone Iodomethane Methylene Chloride	100 -41-4 97-63-2 591-78 - 6 74-88-4 75-09-2	0.005 0.01 0.050 0.01 0.005	HOL HOL HOL HOL
4-Methyl-2-Pentanone Styrene 1,1,2,2-Tetrachloroethane Tetrachloroethylene Toluene	108-10-1 100-42-5 79-34-5 127-18-4 108-88-3	0.050 0.01 0.01 0.01 0.005	BDL BDL BDL BDL BDL
1,1,1-Trichloroethane 1,1,2-Trichloroethane Trichloroethylene Trichlorofluoromethane Vinyl Chloride	71-55-6 79-00-5 79-01-6 75-69-4 75-01-4	0.005 0.005 0.005 0.005 0.01	BOL BOL BOL BOL
Xylene (Total)	1330-20-7	0.005	BDL
Surrogate Recoveries: 1,2-Dichloroethane-D4 Toluene-D8 Bromofluorobenzene			90% 112% 100%

BDL = Below Sample Detection Limit SDL - Sample Detection Limit

comments:	
coments:	

COMPANY NAME: COMPANY PROJECT NUMBER:

DATE/TIME AVALYZED:

HydroLogic-Morris., Inc. FRONT ROYAL ENV./#0013-94-016

HYDROLOGIC PROJECT NUMBER: HYDROLOGIC SAMPLE NUMBER: HYDROLOGIC LAB I.D. #: SAMPLE IDENTIFICATION: DATE SAMPLED: DATE EXTRACTED:

9512070B 399 COMP A 7/17/95 7/20/95 7/20/95

FL9512070B

METHOD SW 846 8270

ANALYSIS	CAS NO.	<u>SDL</u> (mg/kg)	RESULT (mg/kg)
Acenaphthene Acenaphthylene Aniline Anthracene Benzidine	83-32-9 208-96-8 62-53-3 120-12-7 92-87-5	3.0 3.0 3.0 3.0	BOL BOL BOL BOL BOL
Benzoic Acid Benzo(a)Anthracene Benzo(b)Fluoranthene Benzo(k)Fluoranthene Benzo(g,h,i)Perylene	65-85-0 56-55-3 205-99-2 207-08-9 191-24-2	16.5 3.0 3.0 3.0 3.0	BDL BDL BDL BDL BDL
Benzo(a)Pyrene Benzyl Alcohol Bis(2-Chloroethoxy)Methane Bis(2-Chloroethyl)Ether Bis(2-Chloroisopropyl)Ether	50-32-8 100-51-6 111-91-1 111-44-4 39638-32-9	3.0 6.5 3.0 3.0	BDL BDL BDL BDL
Bis(2-Ethylhexyl)Phthalate 4-Bromophenyl Phenyl Ether Butyl Benzyl Phthalate 4-Chloroaniline 1-Chloronaphthalene	117 - 81 - 7 101 - 55-3 85-68-7 106 - 47-8	3.0 3.0 3.0 6.5 3.0	BDL BDL BDL BDL
2-Chloronaphthalene 4-Chloro-3-Methyl Phenol 2-Chlorophenol 4-Chlorophenyl Phenyl Ether Chrysene	91-58-7 59-50-7 95-57-8 7005-72-3 218-01-9	3.0 6.5 3.0 3.0	HDL HDL HDL BDL

HY	D	R	0	L	0	G	1	С	,	J	N_	<u>C</u>	

Page 2 continued

COMPANY NAME: COMPANY PROJECT NUMBER: Hydrologic-Morris., Inc. FRONT ROYAL ENV./#0013-94-016

HYDROLOGIC PROJECT NUMBER: HYDROLOGIC SAMPLE NUMBER: SAMPLE IDENTIFICATION: DATE SAMPLED:

FL9512070B

9512070B COMP A 7/17/95

METHOD SW 846 8270

avalysis	CAS NO.	<u>spr</u> (mg/kg)	(mg/kg)
Dibenz(a,h)Anthracene Dibenzofuran Di-N-Butylphthalate 1,3-Dichlorobenzene 1,4-Dichlorobenzene	53-70-3 132-64-9 84-74-2 541-73-1 106-46-7	3.0 3.0 3.0 3.0 3.0	BDL BDL BDL BDL BDL
1,2-Dichlorobenzene 3,3'-Dichlorobenzidine 2,4-Dichlorophenol 2,6-Dichlorophenol Diethylphthalate	95-50-1 91-94-1 120-83-2 87-65-0 84-66-2	3.0 6.5 3.0 3.0	HOL HOL HOL HOL HOL
A,A-Dimethylphenethylamine 2,4-Dimethylphenol Dimethylphthalate 4,6-Dinitro-2-Methylphenol 2,4-Dinitrophenol	122-09-8 105-67-9 131-11-3 534-52-1 51-28-5	3.0 3.0 3.0 16.5 26.5	EDL EDL EDL EDL
2,4-Dinitrotoluene 2,6-Dinitrotoluene Diphenylamine Di-N-Octylphthalate Fluoranthene	121-14-2 606-20-2 122-39-4 117-84-0 206-44-0	3.0 3.0 3.0 3.0 3.0	BDL BDL BDL BDL
Fluorena Hexachlorobenzena Hexachlorobutadiena Hexachlorocyclopentadiena	86-73-7 118-74-1 87-68-3 77-47-4	3.0 3.0 3.0 3.0	EDL EDL EDL EDL

HY	D	R	0	L	0	G	l	C	,	N	C	
Page		tinued										

COMPANY NAME:

COMPANY PROJECT NUMBER:

Hydrologic-Morris., Inc. FRONT ROYAL ENV./#0013-94-016

HYDROLOGIC PROJECT NUMBER: HYDROLOGIC SAMPLE NUMBER: SAMPLE IDENTIFICATION:

FL9512070B 9512070B

COMP A 7/17/95 DATE SAMPLED:

NETHOD 5W 846 8270

<u>analysis</u>	CAS NO.	<u>SDL</u> (mg/kg)	RESULT (mg/kg)
Hexachlorosthane Indeno(1,2,3-cd)Pyrene Isophorone 2-Methylnaphthalene 2-Methylphenol	67-72-1 193-39-5 78-59-1 91-57-6 95-48-7	3.0 3.0 3.0 3.0 3.0	BDL BDL BDL BDL
4-Methylphenol Naphthalene 2-Nitroaniline 3-Nitroaniline 4-Nitroaniline	106-44-5 91-20-3 88-74-4 99-09-2 100-01-6	3.0 3.0 16.5 16.5	BDL BDL BDL BDL BDL
Nitrobenzene 2-Nitrophenol 4-Nitrophenol N-Nitroso-Di-N-Butylamine N-Nitrosodimethylamine	98-95-3 88-75-5 100-02-7 924-16-3 62-75-9	3.0 3.0 16.5 3.0 3.0	BOL BOL BOL BOL
N-Nitrosodiphenylamine N-Nitrosodipropylamine Pentachlorophenol Phenanthrene Phenol	86-30-6 621-64-7 87-86-5 85-01-8 108-95-2	3.0 3.0 16.5 3.0 3.0	BDL BDL BDL BDL
Pyrene 1,2,4,5-Tetrachlorobenzene 2,3,4,6-Tetrachlorophenol 1,2,4-Trichlorobenzene	129-00-0 95-94-3 58-90-2 120-82-1	3.0 3.0 3.0 3.0	RDL RDL RDL

COMPANY NAME: COMPANY PROJECT NUMBER: HydroLogic-Morris., Inc. FRONT ROYAL ENV. /#0013-94-016

HYDROLOGIC PROJECT NUMBER: HYDROLOGIC SAMPLE NUMBER: SAMPLE IDENTIFICATION:

FL9512070B 9512070B COMP A 7/17/95

DATE SAMPLED:

METIBOD SW 846 8270

ANALYSIS	CAS NO.	<u>SDT.</u> (mg/kg)	result (ng/kg)
2,4,5-Trichlorophenol 2,4,6-Trichlorophenol	95-95-4 88-06-2	3.0 3.0	BDL
Surrogate Recovery: 2-Fluorobiphenyl Nitrobenzene-d5 4-Terphenyl-D14 2-Fluorophenol Phenol-D5 2,4,6-Tribromophenol			85% 65% 86% 102% 103% 109%

BDL	_	Below Sample Detection Limit	Lt
SDL		Sample Detection Limit	

	•
COMMENTS:	

	T TANK SOLE T TAY 502/875-8016	Toll Free 1-800/728-225
1491 Twilight Trail Frankfort, KY 40601	☐ 502/223-0251 LI FAX 502873-0010	

H Y D R O L O G I C , I N C

FINAL REPORT OF ANALYSES

Hydrologic, Inc. (MORRISVILLE)

2500 Gateway Centre

Suite 900

Morrisville, NC 27560-Attn: Pomeroy Smith

SAMPLE NUMBER- 9166 SAMPLE ID- ID# COMP A

DATE SAMPLED- 07/17/95

DATE RECEIVED- 07/18/95 SAMPLER- CLIENT TIME RECEIVED- 0840 DELIVERED BY- FEDX REPORT DATE: 07/25/95

SAMPLE MATRIX- SO TIME SAMPLED- 1100 RECEIVED BY- KAB

Page 1 of 1

ANALYSIS	METHOD	SAMPLE PREP DATE BY	ANALYSIS DATE	BY RESULT	T UNITS	DET. LIMIT
ANIC, SOLID BARIUM, SOLID CADMIUM, SOLID CHROMIUM, SOLID LEAD, SOLID MERCURY, SOLID SELENIUM, SOLID SILVER, SOLID TCLP Arsenic TCLP Barium TCLP Cadmium TCLP Chromium TCLP Lead TCLP Mercury TCLP Selenium TCLP Silver	3050/7061 3050/7080 3050/7130 3050/7190 3050/7420 7471 3050/7740 3050/7760 1311/7061 1311/7080 1311/7130 1311/7190 1311/7420 1311/7470 1311/7740 1311/7760	07/20/95 AKW 07/20/95 AKW 07/20/95 AKW 07/20/95 AKW 07/20/95 AKW 07/18/95 AKW 07/18/95 AKW 07/18/95 AKW 07/18/95 AKW 07/18/95 AKW 07/18/95 AKW	07/21/95 07/20/95 07/20/95 07/20/95 07/20/95 07/20/95 07/20/95 07/21/95 07/21/95 07/21/95 07/21/95	ASM 34 AKW 1 AKW 4 AKW 4 AKW < 0.00 ASM 9 ATR < 0.00 ASM 0 AKW < 0.00 AKW < 0.00 AKW < 0.00 AKW < 0.00 AKW 0.000 ASM 0.000 ASM 0.000	3 mg/L	1.0 1.0 1.0 1.0 0.02 1.0 0.001 0.1 0.005 0.05 0.1 0.0002 0.002

LABORATORY DIRECTOR Leusa W Millanahan

REPORT TO:			
FRONT	KOYAL	ENV.	<u>_</u> 5vcs.
ATTN.	BRYAA	<u>, </u>	

HYDROLOG1C-MUKK.5V

CHAIN OF CHSTODY

HydroLogic, Inc. 2500 Gateway Centre Blvd., Suite 900 Morrisvile, NC 27550 800-241-4174 919-380-9699

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41986

Method of Shipment

952646

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DISPATCHED BY:				DATE	ATE / TIME:				FECENED BY:			ED BY	<u>/:</u>	DATE / TIME:

HYDROLOGIC, INC

.. July 28, 1995.

REPORTING:

HydroLogic Morris., Inc. 2500 Gateway Centre Suite #900 Morrisville, NC 27560

Attention: Pomeroy Smith

PROJECT NUMBER: FL9512238

DATE COMPLETED: July 28, 1995
DATE RECEIVED: July 21, 1995

INVOICING:

Hydrologic Morris., Inc. 2500 Gateway Centre Suite #900 Morrisville, NC 27560

PROJECT DESCRIPTION:

Front Royal/TEER #0013-94-012-1 soil sample analyzed for 3550/5030/9071/8240/8270/TCLP(8240/8270)/pH.

Enclosed is the laboratory report for the project described above. If you have any questions or if we can be of further assistance, please feel free to contact Jamie Fore. We appreciate your business and look forward to serving you again soon.

Respectfully,

Bonn	enjamin Carl Esterle
8	enjamin Carl Esterle
L	aboratory Director

FAX TRANSMITTAL INDROLOGIC, RTP	No. Pages 13
To:	Loyal
Dept:	15:
NOTE:	lu

HYDROLOGIC, INC.

COMPANY NAME:

HydroLogic-Morris., Inc.

COMPANY PROJECT NUMBER:

FRONT ROYAL/TEER #0013-94-012

HYDROLOGIC PROJECT NUMBER: HYDROLOGIC SAMPLE NUMBER:

FI.9512238 9512238

HYDROLOGIC LAB I.D. #: SAMPLE IDENTIFICATION:

399 COMP B 7/20/95

DATE SAMPLED: DATE EXTRACTED: 7/20/95 7/24/95

DATE/TIME ANALYZED:

7/28/95 7/26/95

METHOD TPR 3550/5030

ANALYSIS

CAS NO.

(mg/kg)

(mg/kg)

Diesel

Casoline

11.7

1040

2.0

EDL

RESULT

(mg/kg)

EDL

RESULT

(mg/kg)

BDL = Below Sample Detection Limit

SDL = Sample Detection Limit

COMMENIS: GASOLINE: ESTIMATED QUANTITATION BASED ON REPEATED LOW SURROGATE RECOVERY DUE TO SAMPLE MATRIX INTERFERENCE

HYDROLOGIC, INC.

COMPANY NAME: COMPANY PROJECT NUMBER:

DATE/TIME ANALYZED:

Hydrologic-Morris., Inc. FRONT ROYAL/TEER #0013-94-012

HYDROLOGIC PROJECT NUMBER:
HYDROLOGIC SAMPLE NUMBER:
HYDROLOGIC LAB I.D. #:
SAMPLE IDENTIFICATION:
DATE SAMPLED:
DATE EXTRACTED:

FIJ9512238 9512238 399 COMP B 7/20/95 7/24/95 7/26/95

NETHOD SW 846 8270

analysis	CAS NO.	SDL	RESULT
		(mg/kg)	(mg/kg)
Acenaphthene	83-32-9	3.0	BOL
Acenaphthylene	208-96-8	3.0	EDL
Aniline	62-53 - 3	3.0	BDL
Anthracene	120-12-7	3.0	BDL
Benzidine	92-87-5	3.0	BOL
Benzoic Acid	65-85-0	16.5	BDL
Benzo(a)Anthracene	56-55-3	3.0	BOL
Benzo(b)Fluoranthene	205-99-2	3.0	BDL
Benzo(k)Fluoranthene	207-08-9	3.0	EDL:
Benzo(g,h,i)Perylene	191-24-2	3.0	BDL
Benzo(a)Pyrene	50-32-8	3.0	BOL
Benzyl Alcohol	100-51-6	6.5	BOL
Bis(2-Chloroethoxy)Methane	111-91-1	3.0	BOL
Bis(2-Chloroethyl)Ether	111-44-4	3.0	BDL
Bis(2-Chloroisopropyl)Ether	39638~32~9	3.0	BOL
Bis(2-Ethylhexyl)Phthalate	117-81-7	3.0	BDL
4-Bromophenyl Phenyl Ether	101-55-3	3.0	BDL
Butyl Benzyl Phthalate	85-68-7	3.0	BDL
4-Chlorcaniline	106-47-8	6.5	BDL
1-Chloronaphthalene		3.0	BOL
2-Chloronaphthalene	91-58-7	3.0	HDL
4-Chloro-3-Methyl Phenol	59-50-7	6.5	BDL
2-Chlorophenol	95-57-8	3.0	BDL
4-Chlorophenyl Phenyl Ether	7005-72-3	3.0	BDL
Chrysene	218-01-9	3.0	BDL

Page 2 continued

COMPANY NAME: COMPANY PROJECT NUMBER: Hydrologic-Morris., Inc. FRONT ROYAL/TKER #0013-94-012

HYDROLOGIC PROJECT NUMBER: HYDROLOGIC SAMPLE NUMBER: SAMPLE IDENTIFICATION: DATE SAMPLED: FL9512238 9512238 COMP B 7/20/95

METHOD SW 846 8270

ANALYSIS	CAS NO.	(mg/kg)	(mg/kg)
Dibenz(a,h)Anthracene	53-70-3	3.0	BOL
Dibenzofuran	132-64-9	3.0	BDL
Di-N-Butylphthalate	84-74-2	3.0	BDL
1,3-Dichlorobenzene	541-73-1	3.0	EDL
1,4-Dichlorobenzene	106-46-7	3.0	BDL
1,2-Dichlorobenzens	95-50-1	3.0	BDL
3,3'-Dichlorobenzidine	91-94-1	6.5	BDL
2,4-Dichlorophenol	120-83-2	3.0	BOL
2,6-Dichlorophenol	87-65-0	3.0	BOL
Diethylphthalate	84-66-2	3.0	BOL
A,A-Dimethylphenethylamine	122-09-8	3.0	BOL
2,4-Dimethylphenol	105-67-9	3.0	EDL
Dimethylphthalate	131-11-3	3.0	PDL
4,6-Dinitro-2-Methylphenol	534-52-1	16.5	BDL
2,4-Dinitrophenol	51-28-5	26.5	BDL
2,4-Dinitrotoluene	121-14-2	3.0	HDL
2,6-Dinitrotoluene	606-20-2	3.0	BDL
Diphenylamine	122-39-4	3.0	BDL
Di-N-Octylphthalate	117-84-0	3.0	BDL
Fluoranthene	206-44-0	3.0	BDL
Fluorene	86-73-7	3.0	BDL
Hexachlorobenzene	118-74-1	3.0	BDL
Hexachlorobutadiene	87-68-3	3.0	BDL
Rexachlorocyclopentadiene	77-47-4	3.0	BDL

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Page 3 continued

COMPANY NAME:

HydroLogic-Morris., Inc.

COMPANY PROJECT NUMBER: HYDROLOGIC-MOTILE., INC.

COMPANY PROJECT NUMBER: FROMT ROYAL/TEER #0013-94-012

HYDROLOGIC PROJECT NUMBER: FL9512238 HYDROLOGIC SAMPLE NUMBER: 9512238

COMP B 7/20/95

SAMPLE IDENTIFICATION: DATE SAMPLED:

NETHOD SW 846 8270

ANALYSIS	CAS NO.	<u>spi</u> (mg/kg)	RESULT (mg/kg)
Hexachloroethane	67-72-1	3.0	BOL
Indeno(1,2,3-cd)Pyrene	193-39-5	3.0	BDL
Isophorone	78-59-1	3.0	BDL
2-Methylnaphthalene	91-57-6	3.0	BDL.
2-Methylphenol	95-48-7	3.0	BOL.
4-Methylphenol	106-44-5	3.0	HOL
Naphthalene	91-20-3	3.0	BDL
2-Nitroaniline	88-74-4	16.5	BOL.
3-Nitroaniline	99-09-2	16.5	BOL
4-Nitroaniline	100-01-6	16.5	HDL
Nitrobenzene	98-95-3	3.0	BDL
2-Nitrophenol	88-75-5	3.0	BDL
4-Nitrophenol	100-02-7	16.5	BDL
N-Nitroso-Di-N-Butylamine	924-16- 3	3.0	BDL
N-Nitroscdimethylamine	62-75-9	3.0	BDL
N-Nitrosodiphenylamine	86-30-6	3.0	BOL
N-Nitrosodipropylamine	621-64-7	3.0	BOL
Pentachlorophenol	87-86-5	16.5	BOL
Phenanthrene	85-01-8	3.0	BDL
Phenol	108-95-2	3.0	BOL
Pyrene	129-00-0	3.0	BOL
1,2,4,5-Tetrachlorobenzene	95-94-3	3.0	BDL
2,3,4,6-Tetrachlorophenol	58~90-2	3.0	BDL
1,2,4-Trichlorobenzene	120-82-1	3.0	BOL
· ·			

Page 4 continued

COMPANY NAME:

HydroLogic-Morris., Inc.

COMPANY PROJECT NUMBER:

FRONT ROYAL/TEER #0013-94-012

HYDROLOGIC PROJECT NUMBER: HYDROLOGIC SAMPLE NUMBER: SAMPLE IDENTIFICATION: FL9512238 9512238 COMP B 7/20/95

DATE SAMPLED:

METHOD SW 846 8270

ANALYSIS	CAS NO.	<u>SDL</u> (mg/kg)	RESULT (mg/kg)
2,4,5-Trichlorophenol	95-95-4 88-06 - 2	3.0 3.0	BDL BDL

Surrogate Recovery:
2-Fluorobiphenyl
Nitrobenzene-d5
4-Terphenyl-D14
2-Fluorophenol
Phenol-D5
2,4,6-Tribromophenol

HDI = Below Sample Detection Limit SDL = Sample Detection Limit

COMMENTS: HIGH DETECTION LIMIT AND NO SURROGATE RECOVERY DUE TO A DILLUTION FACTOR X 10 CAUSED BY SAMPLE MATRIX INTERIFERNCE.

HYDROLOGIC, INC.

COMPANY NAME: COMPANY PROJECT NUMBER: HydroLogic-Morris., Inc. FROWT ROYAL/TEER #0013-94-012

HYDROLOGIC PROJECT NUMBER:
HYDROLOGIC SAMPLE NUMBER:
HYDROLOGIC LAB I.D. #:
SAMPLE IDENTIFICATION:
DATE SAMPLED:
DATE EXTRACTED:
DATE/TIME ANALYZED:

FL9512238 9512238 399 COMP B 7/20/95 N/A 7/28/95

METHOD SW 846 8240

analysis	CAS NO.	<u>stri</u> (mg/kg)	RESULT (mg/kg)
Acetone	67-64-1	0.200	BDL
Acrolein	107-02-8	0.050	BOL
Acrylonitrile	107-13-1	0.050	BDL
Benzene	71-43-2	0.005	PDI.
Bromodichloromethane	75-27-4	0.005	BDL
Bromoform	75-25 - 2	0.005	BOL
Bromomethane	74-83 - 9	0.01	BOL
2-Butanone	78 - 93-3	0.100	BDL
Carbon Disulfide	75-15-0	0.005	BDL
Carbon Tetrachloride	5 6- 23-5	0.005	EDL
Chlorobenzene	108-90-7	0.005	RDL
Chloroethane	75-00-3	0.01	BDL
2-Chloro Ethyl Vinyl Ether	110-75-8	0.01	BDL
Chloroform	67-66-3	0.005	BDL
Chloromethane	74-87-3	0.01	BOL
Dibroschloromethane	124-48-1	0.005	HDL
Dibronmethane	74 - 95 - 3	0.005	BDL
1,4-Dichloro-2-Butane		0.005	BOL
Dichlorodifluoromethane	75 ~71 ~8	0.01	BDL
1,2-Dichlorobenzene	95-50-1	0.005	BDL
1,3-Dichlorobenzene	541-73-1	0.005	BDL
1,4-Dichlorobenzene	106-46-7	0.005	BDL
1,1-Dichloroethane	75-34-3	0.005	BDL
1,2-Dichloroethane	107-06-2	0.005	BDL
1,1-Dichloroethene	75-35-4	0.005	BOL

Page 2 continued

COMPANY NAME:

HydroLogic-Morris., Inc.

COMPANY PROJECT NUMBER:

FRONT ROYAL/TEER #0013-94-012

HYDROLOGIC PROJECT NUMBER: HYDROLOGIC SAMPLE NUMBER: SAMPLE IDENTIFICATION: FI.9512238 9512238 COMP B 7/20/95

DATE SAMPLED:

METHOD SN 846 8240

ANALYSIS	CAS NO.	(mg/kg)	(ng/kg)
trans-1,2-Dichloroethene	156-60-5	0.005	BDL
1,2-Dichloropropane	78-87-5	0.005	BOL
cis-1,3-Dichloropropene	10061-01-5	0.005	BOL
trans-1,3-Dichloropropena	10061-02-6	0.005	BDL
Ethanol	64-17-5	0.100	BOL
Rthylbenzene	100-41-4	0.005	BDL
Ethyl Methacrylate	97-63-2	0.01	BDL
2-Hexanone	591-78 - 6	0.050	BDL
Icdomethane	74-88-4	0.01	BOL
Methylene Chloride	75~09~2	0.005	BDL
4-Methyl-2-Pentanone	108-10-1	0.050	BDL
Styrene	100-42-5	0.01	RDL
1,1,2,2-Tetrachloroethane	79 - 34 - 5	0.01	BDL
Tetrachloroethylene	127-18-4	0.01	HDL
Toluene	108-88-3	0.005	BDI.
1,1,1-Trichlorcethane	71-55-6	0.005	BDL
1,1,2-Trichloroethane	79-00-5	0.005	BDL
Trichloroethylene	79-01-6	0.005	BDL
Trichlorofluoromethane	75-69-4	0.005	BDL
Vinyl Chloride	75-01-4	0.01	BDL
Xylene (Total)	1330–20–7	0.005	BDL
Surrogate Recoveries:			
1,2-Dichlorosthane-D4			88%
Toluene-D8			72%
Branofluorabenzene			108%

BDL	-	Below !	Sample I	Set e	ection	Limit
SDL	=	Sample	Detecti	ion	Limit	

COMMENTS:	

	PT - 14 104 45454	CONTRACT OF	- CAY 650/076 0016	1 1	Tall Free	1.800/708.2051
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(42) I MINITE LIGH	Frankfort, KY 40601	— 0101 MHO 1-1 . 1	,			

HYDROLOGIC, INC.

COMPANY NAME:

Hydrologic-Morris., Inc.

COMPANY PROJECT NUMBER:

FRONT ROYAL/TEER #0013-94-012

HYDROLOGIC PROJECT NUMBER: HYDROLOGIC SAMPLE NUMBER: HYDROLOGIC LAB I.D. #: SAMPLE IDENTIFICATION:

FL9512238 9512238 399 COMP B 7/20/95

DATE SAMPLED: DATE EXTRACTED: DATE/TIME ANALYZED: 7/20/95 7/25/95 7/27/95

METROD TCLP 8240

ANALYSIS	CAS NO.	CAS NO. SUL. (mg/L)	
Benzene Carbon Tetrachloride	71-43-2 56 - 23 - 5	0.001 0.001	HDL HDL
Chlorobenzene	108-90-7	0.001	BDL
Chloroform	67-66-3	0.001	BOL
1,4-Dichlorobenzene	106-46-7	0.001	HDL
1,2-Dichloroethane	107-06-2	0.001	BDL
1,1-Dichloroethene	75-35-4	0.001	BOL
2-Butanone	78-93-3	0.100	BDL
Tetrachloroethene	127-18-4	0.001	BDL
Trichloroethene	79-01-6	0.001	BDL
Vinyl Chloride	75-01 -4	0.005	ROL
Surregate Recoveries: 1,2-Dichloroethane-D4 Taluene-D8 Bromofluorobenzene		,	83% 95% 96%

BDL	302	Below	Sample	Dete	ection	Limit
COT	_	C7	N-4-0-4	-:~	Timit	

SDL = Sample Detection Limit

HYDROLOGIC, INC.

COMPANY NAME: COMPANY PROJECT NUMBER: HydroLogic-Morris., Inc. FRONT ROYAL/THER #0013-94-012

HYDROLOGIC PROJECT NUMBER:
HYDROLOGIC SAMPLE NUMBER:
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SAMPLE IDENTIFICATION:
DATE SAMPLED:
DATE EXTRACTED:

DATE/TIME ANALYZED:

FL9512238 9512238 399 COMP B 7/20/95 7/25/95 7/28/95

METHOD TCLP 8270

<u>analysis</u>	CAS NO.	(mg/l)	(mg/l)
1,4-Dichlorobenzene	106-46-7	0.05	BDL
2-Methylphenol	95-48-7	0.05	BDL
3-Methylphenol	108-39-4	0.05	BDL
4-Methylphenol	106-44-5	0.05	BOL
Bexachloroethane	67-72-1	0.05	BOL
Nitrobenzene	98-95-3	0.05	BDI.
Hexachlorobutadiene	87-68-3	0.05	BDL
2,4,6-Trichlorophenol	88-06-2	0.05	BDL
2,4,5-Trichlorophenol	95-95-4	0.25	BDL
2,4-Dinitrotoluene	121-14-2	0.05	HDI.
Hexachlorobenzene	118-74-1	0.05	BDL
Pentachlorophenol	87-86-5	0.25	BOL
Pyridine	110-86-1	0.50	BDL
Surrogate Recoveries:			
2-Fluorophenol			104%
Phenol-D6			82%
Nitrobenzene-D5			102%
2-Fluorobiphenyl			62%
2,4,6-Tribromophenol			70%
Terphenyl-D14			86%
acapacas			

BDL = Below Sample Detection Limit SDL = Sample Detection Limit

N C G R 0 D

COMPANY NAME:

HydroLogic-Morris., Inc.

COMPANY PROJECT NUMBER:

FRONT ROYAL/TEER #0013-94-012

HYDROLOGIC PROJECT NUMBER:

FL9512238

9512238

HYDROLOGIC SAMPLE NUMBER: HYDROLOGIC LAB I.D. #:

SAMPLE IDENTIFICATION:

399

DATE SAMPLED:

COMP B 7/20/95

DATE/TIME <u>ANALYSIS</u>

RESULT UNITS SDL METHOD ANALYZED

Oil and Grease

TPH 9071

mg/kg 10

618

рH

7/25/95 7/25/95

9045

μq

0

7.93

BDL = Below Sample Detection Limit

SDL = Sample Detection Limit

COMMENTS:	
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FINAL REPORT OF ANALYSES

HydroLogic, Inc. (MORRISVILLE)

2500 Gateway Centre

REPORT DATE: 07/27/95

Suite 900

Morrisville, NC 27560-Attn: Pomeroy Smith

SAMPLE NUMBER-

9298 SAMPLE ID- ID# COM B

SAMPLE MATRIX- SO TIME SAMPLED- 1030

DATE SAMPLED- 07/20/95

DATE RECEIVED- 07/21/95 SAMPLER- CLIENT TIME RECEIVED- 0840 DELIVERED BY- FEDX RECEIVED BY- KAB

Page 1 of 1

ANALYSIS METHOD	SAMPLE PREP DATE BY	ANALYSIS DATE BY	RESULT UNITS	DET. LIMIT
ARSENIC, SOLID BARIUM, SOLID CHROMIUM, SOLID LEAD, SOLID MERCURY, SOLID SELENIUM, SOLID SILVER, SOLID TCLP Arsenic TCLP Barium TCLP Cadmium TCLP Chromium TCLP Lead TCLP Mercury TCLP Selenium TCLP Selenium TCLP Silver 3050/76 3050/77 3050	080 07/21/95 AKW 130 07/21/95 AKW 190 07/21/95 AKW 140 07/21/95 AKW 140 07/21/95 AKW 150 07/21/95 AKW 150 07/21/95 AKW 130 07/21/95 AKW 130 07/21/95 AKW 140 07/21/95 AKW 1470 07/21/95 AKW 1470 07/21/95 AKW 1470 07/21/95 AKW	07/24/95 ASI 07/26/95 ASI 07/21/95 ASI 07/25/95 AKI 07/25/95 AKI 07/26/95 ASI 07/25/95 ASI 07/24/95 ASI 07/24/95 ASI 07/24/95 ASI 07/26/95 ASI 07/25/95 AKI 07/25/95 AKI 07/24/95 ASI 07/24/95 ASI 07/24/95 ASI 07/25/95 AKI	170 mg/kg 4 < 1.0 mg/kg 3.7 mg/kg 8.1 mg/kg 6 < 0.02 mg/kg 7 16 mg/kg 7 10 mg/kg 8 < 1.0 mg/kg 8 < 1.0 mg/kg 9 < 0.06 mg/L 9 < 0.05 mg/L 9 < 0.1 mg/L 9 < 0.010 mg/L 9 < 0.005 mg/L 9 < 0.005 mg/L 9 < 0.005 mg/L 9 < 0.005 mg/L	1.0 1.0 1.0 1.0 0.02 1.0 0.002 0.1 0.005 0.05 0.1 0.0002

LABORATORY DIRECTOR Juesa W M. Clanahas

HYDROLOGIC-MORRISVILLE

State of North Carolina Department of Environment, Health and Natural Resources Division of Parks & Recreation

James B. Hunt, Jr., Governor Jonathan B. Howes, Secretary Dr. Philip K. McKnelly, Director



September 1, 1994

Mr. Stephen Chestnut Front Royal Environmental Services, Inc. P.O. Box 4350 Cary, NC 27519-4350

SUBJECT: Rare Species, High Quality Natural Communities, and Significant Natural Areas in the Proposed Project Area along the Eno River in Durham County, NC

Dear Mr. Chestnut:

The North Carolina Natural Heritage Program does not have records of known rare species, high quality natural communities, or significant natural areas occurring in the project site along the Eno River on the Northwest Durham quadrangle. To our knowledge, this project site has not been systematically inventoried and we cannot definitively state that rare species or significant natural areas do not occur there.

Located just 0.15 mile east of this site is an Identified Natural Heritage Area referred to as Eno River Blue Wild Indigo Slopes. Adjacent to this natural area is another Identified Natural Heritage Area referred to as Penny's Bend. These two sites contain the following rare species: Ruellia humilis (Low Wild-petunia), a state Threatened species; Baptisia minor (Prairie Blue Wild Indigo), Parthenium auriculatum (Glade Wild Quinine), Scutellaria leonardii (Shale-barren skullcap), and Silphium terebinthinaceum (Prairie dock), all four state Candidate species; and Lithospermum canescens (Hoary Puccoon) and Matelea decipiens (Glade Milkvine), considered significantly rare in North Carolina. Because of the proximity of this project site to these natural areas and rare species, it is possible that these rare species may also occur at the project site.

Enclosed is a list of rare species that are known to occur in Durham County. If suitable habitat for any of these species occurs in the project area, then those species may be present at the project site.

Also enclosed is a description from Smith et al. 1993 of an Identified Natural Heritage Area referred to as the Eno River Aquatic Habitat. This aquatic habitat is considered to be of National Significance and contains numerous rare aquatic species. It is possible that these rare species may occur near the project site.

Mr. Chestnut Page 2 September 1, 1994

Please contact me at the address below or call me at (919) 733-7701 if you have any questions or need further information.

Sincerely,

Inge Smith

Information Specialist Natural Heritage Program

/iks

Enclosures

SCIENTIFIC AND COMMON NAME		FED. PROT.		GLOBAL RANK
*** Durham				
** Vertebrates	SR		S3	G3
AMBLOPLITES CAVIFRONS	SK		55	00
ROANOKE BASS ETHEOSTOMA COLLIS	sc		S3	G3
CAROLINA DARTER				
HALIAEETUS LEUCOCEPHALUS	E	LE	S1B,S2	G4
BALD EAGLE	sc		S3.	G5
HEMIDACTYLIUM SCUTATUM	SC		55.	65
FOUR-TOED SALAMANDER NECTURUS LEWISI	sc	3 C	S 3	G3
NEUSE RIVER WATERDOG				
NOTURUS FURIOSUS POP 1	SC		S2	G3T2Q
CAROLINA MADTOM NEUSE RIVER POPULATION				
** Invertebrates				
FUSCONAIA MASONI	${f T}$	C2	S1	G2
ATLANTIC PIGTOE		~	G1	C O
GOMPHUS SEPTIMA	SR	C2	S1	G2
SEPTIMA'S CLUBTAIL	SR		S3?	G4
VILLOSA CONSTRICTA NOTCHED RAINBOW.				
NOTOHID TUILISON.				
** Vascular plants	SR		S2?	G4
AGALINIS DECEMLOBA	SK		02.	0.
PIEDMONT GERARDIA ASTER LAEVIS VAR CONCINNUS	С		S2	G5T4
SMOOTH BLUE ASTER				
BAPTISIA MINOR	С		S2	G5T4
PRAIRIE BLUE WILD INDIGO	SR		S2	G3G4
BERBERIS CANADENSIS AMERICAN BARBERRY	ĎI			
CARDAMINE DOUGLASSII	SR		S2	G5
DOUGLASS'S BITTERCRESS				~ .
CAREX BUSHII	SR		S1	G4
BUSH'S SEDGE	SR		S1	G5
CAREX JAMESII JAMES'S SEDGE	DIC		5	•
CAREX MEADII	SR		S1	G4G5
MEAD'S SEDGE	_		G1	C.E.
CAREX VESTITA	С		S1	G5
VELVET SEDGE	E-SC	C2	S1	G3
DELPHINIUM EXALTATUM TALL LARKSPUR				
DESMODIUM OCHROLEUCUM	С		S1?	G2G3
CREAMY TICK-TREFOIL	F CC	יר די	S1	G3
ECHINACEA LAEVIGATA	E-SC	LE	21	GJ
SMOOTH CONEFLOWER ENEMION BITERNATUM	SR		S2	G5
EASTERN ISOPYRUM				
 EUPATORIUM GODFREYANUM	SR		S1	G4
GODFREY'S THOROUGHWORT	SR		S1	G5
EUPATORIUM INCARNATUM	ЛС		O.L	
PINK THOROUGHWORT HEXALECTRIS SPICATA	SR		S2	G4?
CRESTED CORALROOT				

SCIENTIFIC AND COMMON NAME		FED.	STATE RANK	GLOBAL RANK
HEXASTYLIS LEWISII	SR	3C	S3	G3
LEWIS'S HEARTLEAF				9195
LIATRIS SQUARRULOSA	SR		S2	G4G5
EARLE'S BLAZING STAR	an.		S1	G5
LITHOSPERMUM CANESCENS	SR		21	GO
HOARY PUCCOON	SR		S2	G5
MATELEA DECIPIENS	NG.		52	00
GLADE MILKVINE	С	C2	S2	G3
MONOTROPSIS ODORATA	C	0.0		
SWEET PINESAP	SR	3C	S3	G3G4
NESTRONIA UMBELLULA				
NESTRONIA	SR		S2	G5
PANAX TRIFOLIUS DWARF GINSENG				
PANICUM FLEXILE	SR		S1	G3G5
WIRY PANIC GRASS				
PARTHENIUM AURICULATUM	С		S1	G3?Q
GLADE WILD QUININE				
PLATANTHERA PERAMOENA	C	3C	S1	G5
PURPLE FRINGELESS ORCHID				a=
PORTERANTHUS STIPULATUS	SR		S2	G5
INDIAN PHYSIC	_		OII.	G5T4
PRUNUS PUMILA VAR SUSQUEHANAE	С		SH	G5T4
SUSQUEHANNA CHERRY	70 C.C	LE	S2	G2
RHUS MICHAUXII	E-SC	T.D.	52	GZ
MICHAUX'S SUMAC	т		S1	G5
RUELLIA HUMILIS	Ţ		D.I.	05
LOW WILD-PETUNIA	SR		S1S2	G5
RUELLIA PURSHIANA	DIC			
PURSH'S WILD-PETUNIA	SR		S1	G5
SCIRPUS PENDULUS				
RUFOUS BULRUSH SCUTELLARIA LEONARDII	C		S1	G4T4
SCUTELLARIA DECNARDII SHALE-BARREN SKULLCAP				
SCUTELLARIA NERVOSA	SR		S1	G5
VEINED SKULLCAP				
SILPHIUM TEREBINTHINACEUM	С		S2	G4G5
PRAIRIE DOCK				
SOLIDAGO RIGIDA SSP GLABRATA	SR		S2	G5T4
SOUTHEASTERN BOLD GOLDENROD				
** Nonvascular plants	_	an.	SH	G1
PLAGIOCHILA COLUMBIANA	С	C2	Sn	GI
A LIVERWORT				
** Natural communities			S2	G5T3
BASIC MESIC FOREST (PIEDMONT SUBTYPE)				
AND WICKORY FORESE			S3	G4
BASIC OAKHICKORY FOREST				
DRY-MESIC OAKHICKORY FOREST			S 5	G5
DKI-WEDIC OWWHICKOWI LOWDOIL				_
FLOODPLAIN POOL			S2	G3?
LIOODEHVIK 100F				
MESIC MIXED HARDWOOD FOREST (PIEDMONT SUBTYP	E		S4	G5T5
THOSE THAT				

.

	SCIENTIFIC AND COMMON NAME		STATE RANK	GLOBAL RANK
_	PIEDMONT MONADNOCK FOREST		S4	G5
	PIEDMONT/COASTAL PLAIN HEATH BLUFF		S3	G4?
	PIEDMONT/LOW MOUNTAIN ALLUVIAL FOREST		S5	G 5
	PIEDMONT/MOUNTAIN BOTTOMLAND FOREST		S3?	G 5
	PIEDMONT/MOUNTAIN LEVEE FOREST		s3?	G5
	PIEDMONT/MOUNTAIN SEMIPERMANENT IMPOUNDMENT		S4	G5
	PIEDMONT/MOUNTAIN SWAMP FOREST		S1	G2
	UPLAND DEPRESSION SWAMP FOREST		S2	G3
	UPLAND POOL		S1	G1
	XERIC HARDPAN FOREST		S3	G3G4

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NATURAL HERITAGE ELEMENTS AND SPECIES STATUS CODES

The attached output from the N.C. Natural Heritage Program database is a listing of the elements (rare species, geologic features, natural communities, and special animal habitats) known to occur in your geographic area of interest. The information on this printout is compiled from a variety of sources, including field surveys, museums and herbaria, literature, and personal communications. The database is dynamic, with new records being added and old records being revised as we receive new information. The enclosed list cannot be considered a definitive record of natural heritage elements, and it should not be considered a substitute for field surveys. When this information is used in any document, we request that the printout date be given and that the Natural Heritage Program be credited.

This cover sheet explains the four columns of status codes that are given on the right-hand side of the printout.

STATE PROTECTION

CODE	STATUS	CODE	STATUS
E	Endangered	SR	Significantly Rare
T.	Threatened	V	Vulnerable
sc	Special Concern	UNK	Undetermined
C	Candidate	EX	Extirpated
P	Proposed (E, T, or C)		

Plant statuses are determined by the Plant Conservation Program (N.C. Dept. of Agriculture) and the Natural Heritage Program (N.C. Dept. of Environment, Health, and Natural Resources). E, T, and SC species are protected by state law (the Plant Protection and Conservation Act, 1979); C and SR designations indicate rarity and the need for population monitoring and conservation action, as determined by the Plant Conservation and Natural Heritage Programs.

Animal statuses that indicate state protection (E, T, and SC) are published in "Endangered Wildlife of North Carolina", March 16, 1992, N.C. Nongame and Endangered Wildlife Program. The Significantly Rare, Undetermined, Vulnerable and Extirpated statuses are (for the most part) Natural Heritage Program designations. They indicate rarity and the need for population monitoring and conservation action.

FEDERAL PROTECTION

The current federal status is listed in "Endangered and Threatened Wildlife and Plants, July 15, 1991 (50 CFR 17.11 & 17.12, Department of the Interior). Definitions are taken from the Endangered Species Act of 1973, as amended through the 100th Congress (1988), and the Federal Register, Part VIII, November 21, 1991 (50 CFR 17, Department of the Interior).

CODE	STATUS	DEFINITION
E	Endangered	A taxon which "is in danger of extinction throughout all or a significant portion of its range"
T	Threatened	A taxon "which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range"
P_	Proposed	A taxon which has been proposed for official listing as endangered or threatened
L_	Listed	A taxon which has been officially listed as endangered or threatened
Cl	Category 1 ("Candidate 1")	A taxon which is under consideration, and for which there is sufficient information to support listing

110m. - The omittee et al. Regional inventory for critical natural area wetland ecosystems and endangered species habitats of the

Albemarle-Pamlico estuarine region: Phase 3. N.C. Natural Heritage Program I DEHNR, Raleigh, N.C.

NAME: Eno River Aquatic Habitat

SIZE: about 15 air miles long SITE CODE: AH4

SITE SIGNIFICANCE: A (National)

COUNTY: Orange, Durham

QUADRANGLE: Cedar Grove, Efland, Hillsborough, Northwest Durham

LOCATION: The Eno River Aquatic Habitat is located in the headwaters of the Neuse River Basin and is entirely contained within the Piedmont Province of North Carolina. The significant portion of the aquatic habitat extends from just above the confluence of the West and East Forks of the Eno in the northern portion of Orange County to its entry into the Durham Triassic Basin downstream from US 501 in Durham.

SIGNIFICANT FEATURES:

1. Three Federal Candidate mussel species are present in this aquatic habitat: the Atlantic pigtoe (Fusconaia masoni) and the yellow lampmussel (Lampsilis cariosa), also State Threatened species; and the green floater mussel (Lasmigona subviridis), also a State Endangered species.

2. Three additional rare species of mussels also occur in the Eno River: the squawfoot (Strophitus undulatus), statelisted as Threatened; the eastern lampmussel (Lampsilis radiata), state-listed as Special Concern; and the notched rainbow (Villosa constricta), considered significantly rare in North Carolina.

3. The Neuse River waterdog (Necturus lewisi), a salamander state-listed as Special Concern, occurs in the Eno.

4. Two species of fish of state-listed as Special Concern found in Eno are the Carolina darter (Etheostoma collis) and the Carolina madtom (Noturus furiosus, pop. 1). The Roanoke bass (Ambloplites cavifrons), considered significantly rare in North Carolina, is also native to the Eno River.

5. Septima's clubtail dragonfly (Gomphus septima), a globally rare species and a Federal Candidate species, has been reported from the Eno, as has the panhandle pebblesnail (Somatogyrus virginicus), a globally rare freshwater snail.

GENERAL DESCRIPTION:

The Eno River is one of the main headwater tributaries of the Neuse River. It is located entirely within the Piedmont Province and over most of its course flows through the Carolina Slate Belt. Within this section, which is the most biologically significant, it possesses extensive areas of riffles interspersed between long, deep pools. The riffle areas are particularly well-developed in the reach located just west of the river's entry into the lowlands of the Durham Triassic Basin. Due to the strong stream-cutting action created by a sharp drop in elevation, the Eno has carved out a series of steep scenic bluffs within this reach, much of which has been protected within the Eno River State Park. The river is also broad enough along this reach to lack an over-arching canopy and the riffle areas consequently support rich growths of herbaceous water willow (Justicia americana).

Nearly all the rare species found in the Eno occur upstream from the Triassic Basin. This is due partly to the presence in this reach of the riffle and pool habitats preferred by several species of the rare mussels; the Carolina darter, Septima's clubtail, and panhandle pebblesnail also occur only in this type of habitat. The other reason is that the water quality is generally higher in this section, which has been rated as Good to Excellent according to both biological and chemical-physical parameters (Water Quality Planning Branch 1992). Even though the reach downstream from the city of Durham's Wastewater Plant has also been given a Good rating, fish kills have been noted in this reach (Water Quality Planning Branch 1992) and native mussels become very scarce from below the plant all the way to Falls Lake (S. Hall, pers. obs.).

At the upstream end, species of non-listed <u>Elliptio</u> mussels have been found as far as the bridge over the West Fork of the Eno located just west of Creedmoor (Howard and Hartley 1992); they probably occur as far up as the limits of the perennial flow. The rarer species occur further downstream, however. Notched rainbow mussels (<u>Villosa constricta</u>) and Carolina darters (<u>Etheostoma collis</u>), both of which are associated with small piedmont streams, have been recorded as far upstream as the vicinity of the confluence of the two forks of the Eno located southwest of Lake Orange. The squawfoot (<u>Strophitus undulatus</u>) has also been found upstream from Corporation Lake (Howard and Hartley 1992).

The remaining rare species are all found below Corporation Lake. Apart from the Neuse River waterdog, which prefers broader and slower reaches, most of the rare species are concentrated between US 70 east of Hillsborough and Guess Road, at the downstream boundary of the Eno River State Park (Alderman 1991; Howard and Hartley 1992). Septima's clubtail and the panhandle pebblesnail have only been recorded at Guess Road (Schweitzer 1989; Bill Adams, pers. comm.).

OWNERSHIP: Eno River State Park includes an approximately 18 river mile reach of the river. The Eno River Association, a private conservation organization, also owns land adjoining the park. West Point on the Eno is a county park located immediately downstream from the state park boundary at Guess Road. Duke Forest, owned by Duke University, occupies land on both sides of the river just west of Hillsborough. The river itself is considered to be Waters of the State while adjoining lands along the river are privately owned.

PROTECTION STATUS: Proposed for Critical Habitat Status but not yet adopted.

MANAGEMENT OR PROTECTION RECOMMENDATIONS:

The Eno River Wastewater Plant located east of US 15-501 is slated for closure within the next several years, which should greatly improve water quality within the Durham Basin reach of ... the Eno. The transfer of discharge to Ellerbe Creek may, however, create dewatering problems that may become significantduring times of drought. The construction of new reservoirs to___ supply the rapidly growing population of this region may also have adverse effects on the level of stream flow.

Other point sources, including the Hillsborough wastewater plant and several package plants, should be maintained or modified to ensure the continued integrity of the Eno River Aquatic Habitat. The elimination of chlorine from the effluents discharged by these plants should be a major goal, since both chlorine and chloramines are well-known to be quite toxic to mollusks and other aquatic organisms.

Sedimentation and non-point runoff should also be controlled. This will be one of the major goals of the Basinwide Water Quality Management Plan, if it becomes adopted. Further acquisition of land by the Eno River State Park will also aid in controlling erosion and runoff from properties that might otherwise be developed, timbered, or plowed.

In order to be effective, water quality protection is needed not only for the reach that contains the significant biological resources, but should also be considered for all reaches upstream. Point and non-point sources of pollution, such as toxic spills, discharges from wastewater plants, and runoff from agricultural fields, clearcuts and impervious surfaces, occurring in headwaters have impacts not only on the portions of the streams they feed directly into, but also as far downstream as the water flows.

Official designation of the Eno as Critical Habitat and as High Quality Waters would also afford important protection by requiring both modernization of all treatment plants discharging into the Eno and the control of erosion and runoff from adjoining uplands in the basin.

COMMENTS: The Eno River Aquatic Habitat has been proposed to the Wildlife Resources Commission and the Environmental Management Commission to be designated as Critical Habitat and High Quality Waters (Nongame and Endangered Wildlife Program 1992). Under the designation of High Quality Waters this aquatic habitat would be protected by Environmental Management Commission regulations.

REFERENCES:

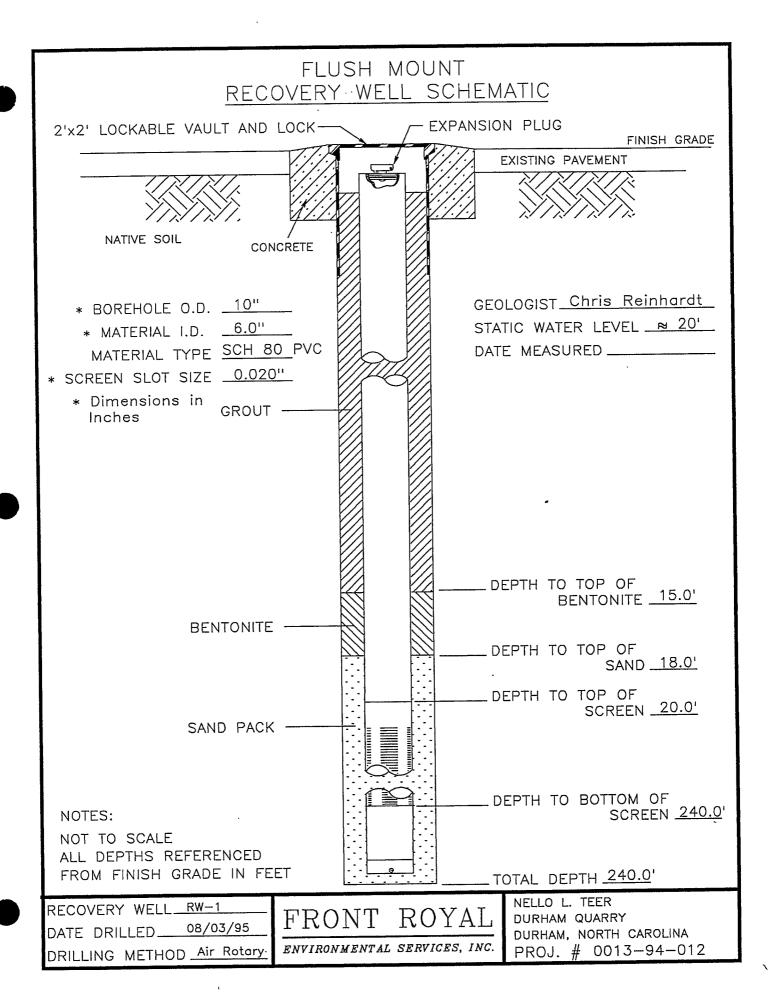
Alderman, J.M. 1991. North Carolina status surveys for Fusconaia masoni, Elliptio lanceolata, and Toxolasma pullus. Nongame Project Report to U.S. Fish and Wildlife Service. Nongame and Endangered Wildlife Program, N.C. Wildlife Resources Commission, Division of Wildlife Management, Raleigh, N.C.

- Howard, J. and S. Hartley. 1992. Status survey of the mollusks of the Eno River. Nongame Small Grants Project Interim Report.
- Nongame and Endangered Wildlife Program. 1992. High quality waters requests. Report to the North Carolina Environmental Management Commission. N.C. Wildlife Resources Commission, Raleigh, N.C.
- Schweitzer, D. 1989. A review of Category 2 Insects in USFWS
 Regions 3, 4, 5. Report to US Fish and Wildlife Service, 1
 Gateway Center, Newton Corners, MA.
- Water Quality Planning Branch. 1992. Neuse River Basinwide Water Quality Management Plan. Draft Report to the North Carolina Division of Environmental Management, Raleigh, N.C.

Quad. No Lat.		Serial	No	
Minor Basin	Long.			
Basin Code _				
Header Ent.		GW-1	Ent.	

RILLING CONTRACTOR Front Royal Environmental RILLER REGISTRATION NUMBER 1597	STATE WELL CONSTRUCTION PERMIT NUMBER: 0500030								
. WELL LOCATION:(Show sketch of the location below) Nearest Town: Denfield Street (Road, Community, or Subdivision and Lot No.)		ty: <u>Durham</u> pth To	<u>DRILLING LOG</u> Formation Description						
. OWNER <u>Teer Company</u> ADDRESS <u>Research Triangle Park</u> NC <u>27709</u> City or Town State Zip Code	0 8 14 20	8 14 20 24	Gravel Fill Layered Clays/Sands Red Siltstone Gray Sandstone						
. DATE DRILLED 8/3/95 USE OF WELL	24 26 30 33	26 30 33 47	Red Siltstone Gray Sandstone Black Siltstone Gray Sandstone						
. TOTAL DEPTH 260' CUTTINGS COLLECTED XXYes No . DOES WELL REPLACE EXISTING WELL? XXXYes No	47 48 85	48 85 110	Red Siltstone Gray Sandstone Red Siltstone						
S. STATIC WATER LEVEL:FTabove TOP OF CASINGbelow TOP OF CASING IS FTbelow LAND SURFACE	110 200 250	200 250 260	Diabase Gray Sandstone w/ Qtz Pebbles Felsic Meta-Volcanic Rock						
7. YIELD (gpm): METHOD OF TEST									
P. CHLORINATION: Type N/A Amount									
IO.CASING: Wall Thickness or Depth Diameter Weight/Ft. Ma	terial	If addit	ional space is needed use back of form						
From 0 To 15 Ft. 10" SCH80 From 0 To 20 Ft. 6" SCH80 From To Ft.	PVC PVC	(Show di two Sta	rection and distance from at least te Roads or other map reference points ATTACHED						
1.GROUT: Depth Material Method									
From 0 To 15 Ft. Neat Cement Pumped From 15 To 18 Ft. Bentonite Pumped 12.SCREEN									
Depth Diameter Slot Size Material From 20 To 240 Ft. 6 in. 0.020 in. PVC From To Ft. in. in. in.									
From To Ft. in. in. 3.GRAVEL PACK: Depth Size Material									
From 18 To 240 Ft. #3 Coarse Sand From To Ft.			·						
14.REMARKS:			CORDANCE WITH 15 NCAC 2C. WELL CONSTRUCTION STANDA						

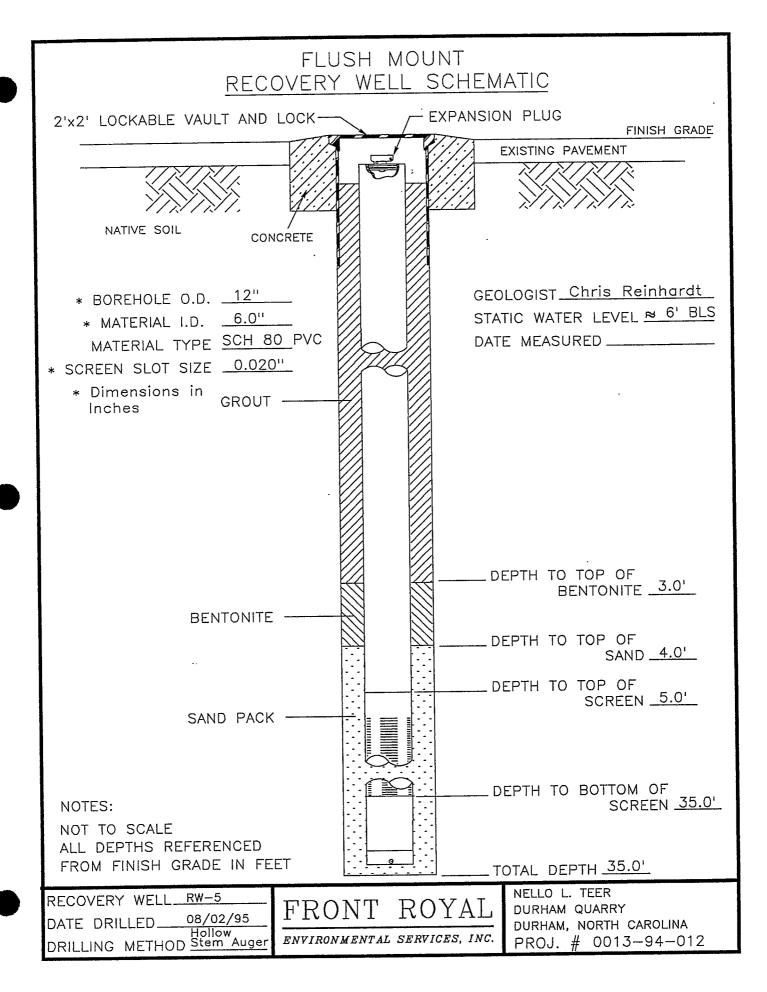
SIGNATURE OF CONTRACTOR OR AGENT



Quad. No Lat.		CE USE ONLY Serial No Pc	
Minor Basin	_		
Basin Code Header Ent.		GW-1 Ent.	

Denfield Street	If additional space is needed use back of form
12.SCREEN Depth Diameter Slot Size Material	
FromToFt	STRUCTED IN ACCORDANCE WITH 15 NCAC 2C. WELL CONSTRUCTION STANDAR

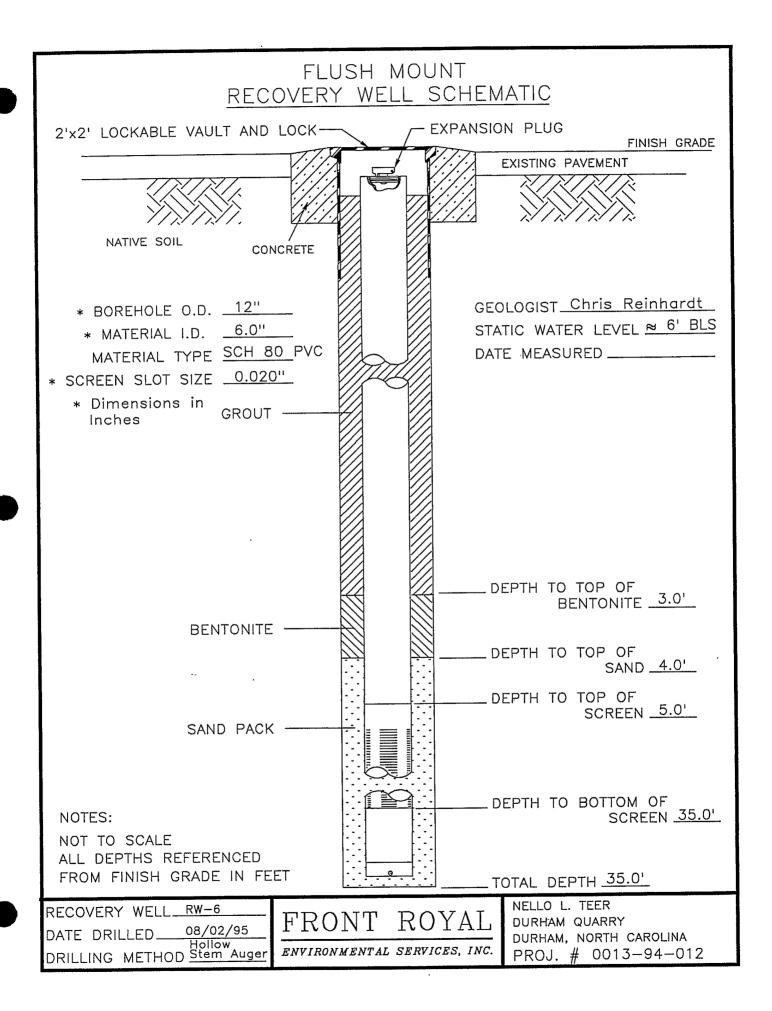
Submit original to Division of Environmental Management and copy to well owner.



	R OFFI	CE USE (Serial		
Lat. Minor Basin			_	
Basin Code Header Ent.		GW-1	Ent.	

DRILLING CONTRACTOR Front Royal Environmental DRILLER REGISTRATION NUMBER 1597	STATE WELL CO PERMIT NUMBER	
1. WELL LOCATION:(Show sketch of the location below) Nearest Town: Denfield Street (Road, Community, or Subdivision and Lot No.)	County: <u>Durham</u> <u>Depth</u> From To	<u>DRILLING LOG</u> Formation Description
2. OWNER Teer Company ADDRESS Research Triangle Park City or Town State Zip Code 3. DATE DRILLED 8/2/95 USE OF WELL 4. TOTAL DEPTH 35' CUTTINGS COLLECTED XXYesNo	0 6 6 14 14 16 16 22 22 29 29 35 35 40	Gravel Fill Wet a 6' Silty Sand Mudstone Sandstone Mudstone Siltstone Sandstone
5. DOES WELL REPLACE EXISTING WELL?Yes XXXNO 6. STATIC WATER LEVEL:FTabove TOP OF CASINGbelow		
From 0 To 5 Ft. 6" SCH80	aterial PVC (Show di	ional space is needed use back of form LOCATION SKETCH rection and distance from at least te Roads or other map reference points
ToFt		ATTACHED
13.GRAVEL PACK:		ORDANCE WITH 15 NCAC 2C. WELL CONSTRUCTION STANDARD

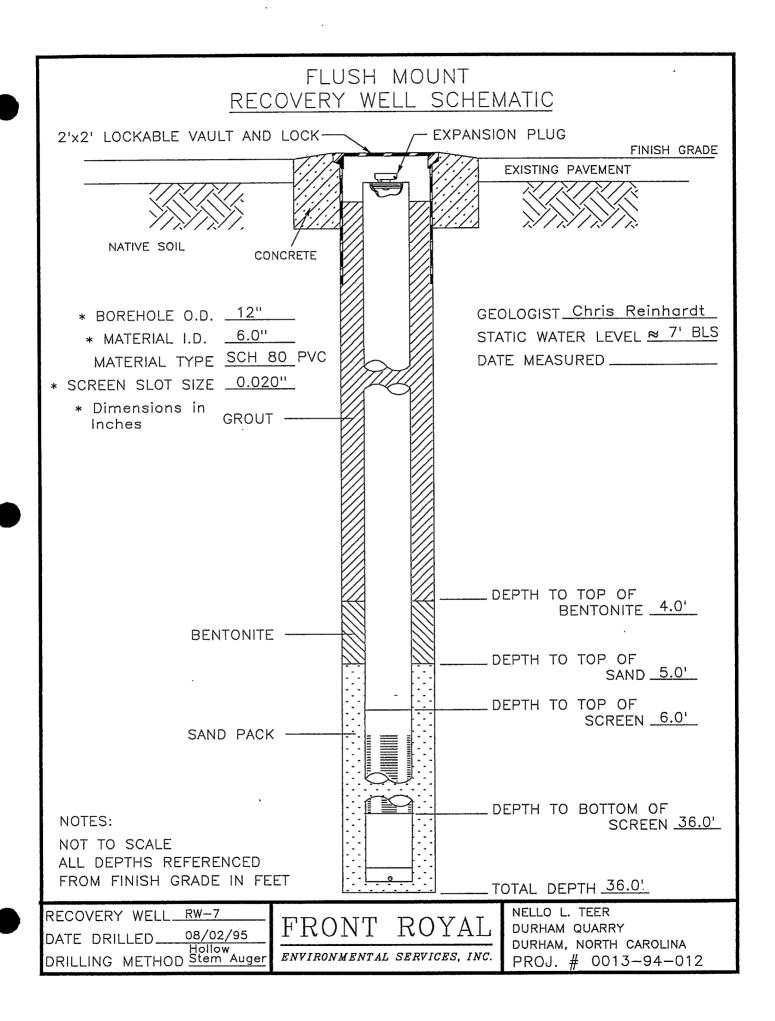
Submit original to Division of Environmental Management and copy to well owner.

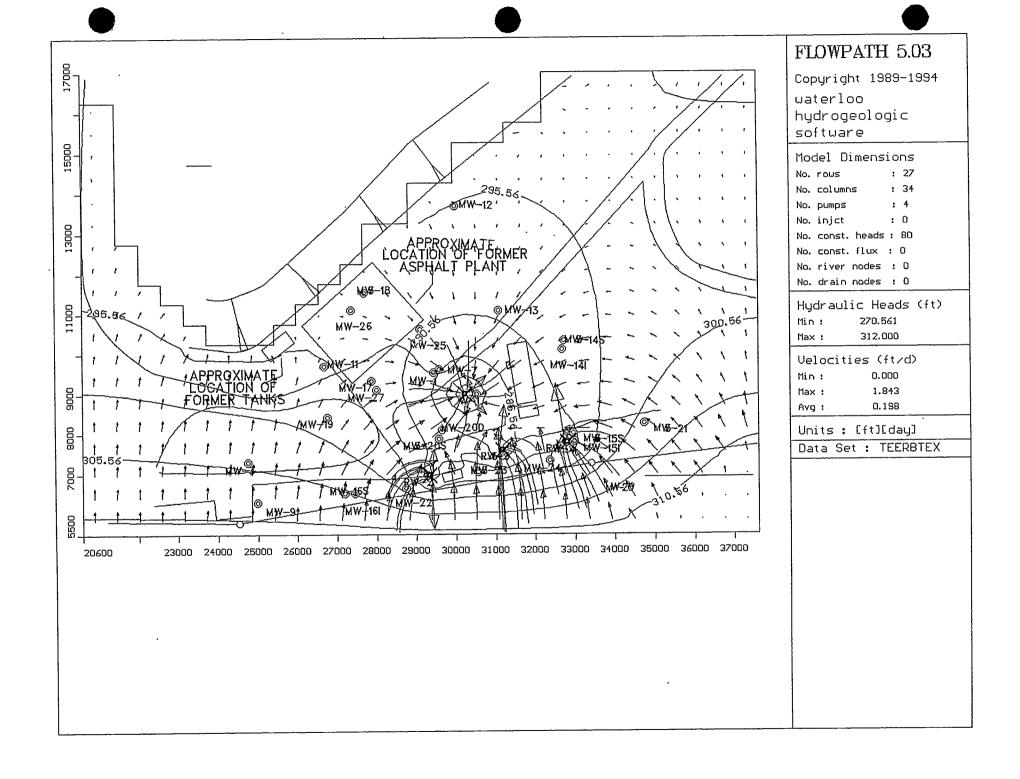


Quad. No.	FOR OFFI	CE USE (Serial		
adad. Mo				
Lat.	Long.		Рc	
Minor Basi	n			
Basin Code				
Header Ent	• .	GW-1	Ent.	
neudoi Liii	•• ———			

WELL CONSTRUCTION RECORD RW-7

. WELL LOCATION:(Show sketch of the location below)		
Nearest Town: <u>Durham</u> <u>Denfield Street</u> (Road, Community, or Subdivision and Lot No.)	County: <u>Durham</u> <u>Depth</u> From To	<u>DRILLING LOG</u> Formation Description
OWNER Teer Company	0 15 15 36	Gravel Fill Sandstone/Siltstone
DATE DRILLED 8/2/95 USE OF WELL Recovery TOTAL DEPTH 36' CUTTINGS COLLECTED XXYESNO DOES WELL REPLACE EXISTING WELL?YES XXXNO		
S. STATIC WATER LEVEL:FTabove TOP OF CASINGbelow		
Dopan Brames.	If addi Material	tional space is needed use back of form LOCATION SKETCH irection and distance from at least ate Roads or other map reference points
From To Ft. 11.GROUT: Depth Material Method From 1 To 4 Ft. Cement Poured From 4 To 5 Ft. Bentonite Poured		ATTACHED
12.SCREEN Depth Diameter Slot Size Material From 6 To 36 Ft. 6 in. 0.020 in. PVC From To Ft. in. in. in. in. From To Ft. in. in. in. in.		
13.GRAVEL PACK: Depth Size Material From 5 To 36 Ft. 0.030 Coarse Sand From To Ft.	_	
14.REMARKS:	S CONSTRUCTED IN AC	CORDANCE WITH 15 NCAC 2C. WELL CONSTRUCTION STANDARDS





ECHOPRINT FLOWPATH

version 5.0

FLOWPATH was written by Thomas Franz and Nilson Guiguer Copyright 1989-1994

by

Waterloo Hydrogeologic Software 200 Candlewood Crescent Waterloo, Ontario N2L 5Y9, Canada ph (519) 746-1798

FLOWPATH logbook for data set: TEERBTEX

Unit System: English units [ft/gal/d]

***** GRID PARAMETERS *****

Number of x-grid lines: 34

Number of y-grid lines: 27

Grid coordinates (x-grid lines) [ft]:

- 1 2.060E+0004
- 2 2.117E+0004
- 3 2.173E+0004
- 4 2.230E+0004
- 5 2.287E+0004
- 6 2.343E+0004
- 7 2.400E+0004
- 8 2.457E+0004
- 9 2.513E+0004
- 10 2.570E+0004
- 11 2.627E+0004
- 12 2.683E+0004
- 13 2.740E+0004
- 14 2.797E+0004
- 15 2.853E+0004
- 16 2.910E+0004
- 17 2.932E+0004
- 18 2.967E+0004
- 19 3.023E+0004
- 20 3.080E+0004 21 3.119E+0004
- 22 3.137E+0004
- 23 3.193E+0004
- 24 3.250E+0004

- 25 3.282E+0004
- 26 3.307E+0004
- 27 3.363E+0004
- 28 3.420E+0004
- 29 3.477E+0004
- 30 3.533E+0004
- 31 3.590E+0004
- 32 3.647E+0004 33 3.703E+0004
- 34 3.760E+0004
- Grid coordinates (y-grid lines) [ft]:

1 5.500E+0003

- 2 6.000E+0003
- 3 6.500E+0003
- 4 6.962E+0003
- 5 7.000E+0003
- 6 7.500E+0003
- 7 7.584E+0003
- 8 7.775E+0003
- 9 8.000E+0003
- 10 8.500E+0003
- 11 9.000E+0003
- 12 9.500E+0003
- 13 1.000E+0004
- 14 1.050E+0004
- 15 1.100E+0004
- 16 1.150E+0004
- 17 1.200E+0004
- 18 1.250E+0004
- 19 1.300E+0004
- 20 1.350E+0004
- 21 1.400E+0004
- 22 1.450E+0004
- 23 1.500E+0004
- 24 1.550E+0004
- 25 1.600E+0004
- 26 1.650E+0004
- 27 1.700E+0004

***** WELL PARAMETERS *****

Number of wells: 4

No.	i	j	X [ft]	[ft]		ell disc od]	harge
1	19	11	3.023E+	-0004	9.000E+0	0003 -	2.160E+0004
2	17	4	2.932E+	0004	6.962E+0	003 -	1.440E+0004
3	21	7	3.119E+	0004	7.584E+0	003 -	1.440E+0004
4	25	8	3.282E+	0004	7.775E+0	003 -	1.440E+0004

***** CONSTRAINED HEAD NODES *****

Number of constant head nodes: 80

No.	i	j	X	Y const.	head
			[ft] [ft	i] [ft]	
1	1	1	2.060E+0004	5.500E+0003	3.120E+0002
2	2	1	2.117E+0004	5.500E+0003	3.120E+0002
3	3	1	2.175E+0004	5.500E+0003	3.120E+0002
4	4	1	2.229E+0004	5.500E+0003	3.120E+0002
5	5	1	2.286E+0004	5.500E+0003	3.120E+0002
6	6	1	2.343E+0004	5.500E+0003	3.120E+0002
7	7	1	2.401E+0004	5.500E+0003	3.120E+0002
8	8	1	2.458E+0004	5.500E+0003	3.120E+0002
9	9	1	2.512E+0004	5.500E+0003	3.120E+0002
10	10	1	2.569E+0004	5.500E+0003	3.120E+0002
11	11	1	2.627E+0004	5.500E+0003	3.120E+0002
12	. 12	1	2.684E+0004	5.500E+0003	3.120E+0002
13	13	1	2.741E+0004	5.500E+0003	3.120E+0002
14	. 14	1	2.795E+0004	5.500E+0003	3.120E+0002
15	15	1	2.853E+0004	5.500E+0003	3.120E+0002
16	16	1	2.910E+0004	5.500E+0003	3.120E+0002
17	17	1	2.934E+0004	5.500E+0003	3.120E+0002
18	18	1	2.967E+0004	5.500E+0003	3.120E+0002
19	19	1	3.025E+0004	5.500E+0003	3.120E+0002
20	20	1	3.079E+0004	5.500E+0003	3.120E+0002
21	. 21	1	3.119E+0004	5.500E+0003	3.120E+0002
22	22	1	3.136E+0004	5.500E+0003	3.120E+0002
23	23	1	3.193E+0004	5.500E+0003	3.120E+0002
24	24	1	3.251E+0004	5.500E+0003	3.120E+0002
25	25	1	3.281E+0004	5.500E+0003	3.120E+0002
26		1	3.308E+0004	5.500E+0003	3.120E+0002
27	7 27	1	3.362E+0004	5.500E+0003	3.120E+0002

```
3.419E+0004
                           5.500E+0003
                                          3.120E+0002
    28
         1
28
                                          3.120E+0002
                           6.006E+0003
29
    29
         2
             3.477E+0004
             3.534E+0004
                                          3.120E+0002
                           6.006E+0003
30
    30
          2
                                          3.120E+0002
    31
          3
             3.591E+0004
                           6.512E+0003
31
32
    32
          4
             3.645E+0004
                           6.950E+0003
                                          3.120E+0002
                                          3.120E+0002
          6
             3.703E+0004
                           7.490E+0003
33
    33
                                          3.120E+0002
                           7.760E+0003
34
    34
          8
             3.760E+0004
                                          2.950E+0002
                           9.986E+0003
     9
        13
             2.512E+0004
35
                                          2.950E+0002
                            1.049E+0004
    10
         14
             2.569E+0004
36
                                          2.950E+0002
                            1.100E+0004
             2.627E+0004
37
    11
         15
                            1.150E+0004
                                          2.950E+0002
         16
             2.684E+0004
38
    12
                                          2.950E+0002
             2.741E+0004
                            1.201E+0004
    13
         17
39
                            1.252E+0004
                                          2.950E+0002
             2.795E+0004
40
    14
         18
                            1.299E+0004
                                          2.950E+0002
         19
             2.795E+0004
    14
41
                            1.299E+0004
                                          2.950E+0002
         19
             2.853E+0004
    15
42
                            1.349E+0004
                                          2.960E+0002
    16
         20
             2.910E+0004
43
                                          2.960E+0002
                            1.400E+0004
         21
             2.934E+0004
44
    17
                                          2.960E+0002
                            1.400E+0004
    18
         21
             2.967E+0004
45
                                          2.960E+0002
         22
             3.025E+0004
                            1.451E+0004
    19
46
                                          2.960E+0002
                            1.501E+0004
              3.025E+0004
47
     19
         23
                                          2.960E+0002
                            1.501E+0004
         23
              3.079E+0004
48
    20
         23
              3.119E+0004
                            1.501E+0004
                                          2.960E+0002
    21
49
                                           2.960E+0002
                            1.501E+0004
50
    22
         23
              3.136E+0004
                                          2.960E+0002
              3.136E+0004
                            1.548E+0004
    22
         24
51
                            1.548E+0004
                                           2.970E+0002
52
    23
         24
              3.193E+0004
                                           2.970E+0002
53
     24
         25
              3.251E+0004
                            1.599E+0004
                                           2.970E+0002
         26
                            1.650E+0004
54
     24
              3.251E+0004
                            1.650E+0004
                                           2.970E+0002
         26
              3.281E+0004
55
     25
                                           2.970E+0002
                            1.700E+0004
         27
              3.281E+0004
56
     25
                                          2.950E+0002
                            9.986E+0003
             2.458E+0004
57
     8
         13
                            9.986E+0003
                                          2.950E+0002
     7
             2.401E+0004
         13
58
                                          2.950E+0002
         13
             2.343E+0004
                            9.986E+0003
59
     6
                                           2.950E+0002
         27
              3.760E+0004
                            1.700E+0004
60
     34
                                           2.950E+0002
                             1.700E+0004
         27
              3.703E+0004
     33
61
                                           2.950E+0002
                             1.700E+0004
     32
         27
              3.645E+0004
62
                                           2.950E+0002
                             1.700E+0004
63
     31
         27
              3.591E+0004
                                           2.950E+0002
                             1.700E+0004
         27
              3.534E+0004
     30
64
                             1,700E+0004
                                           2.960E+0002
         27
              3.308E+0004
     26
65
                                           2.960E+0002
                             1.700E+0004
     27
         27
              3.362E+0004
66
                                           2.960E+0002
              3.419E+0004
                             1.700E+0004
     28
         27
67
                             1.700E+0004
                                           2.960E+0002
     29
         27
              3.477E+0004
68
                                           2.950E+0002
      5
         14
              2.286E+0004
                            1.049E+0004
69
                                           2.940E+0002
                            1.100E+0004
70
      5
         15
              2.286E+0004
                            1.150E+0004
                                           2.940E+0002
         16
              2.229E+0004
      4
71
                                           2.940E+0002
              2.175E+0004
                            1.201E+0004
      3
         17
 72
                                           2.930E+0002
                            1.252E+0004
      3
         18
              2.175E+0004
 73
```

```
1.299E+0004
                                       2.930E+0002
            2.117E+0004
74
                                        2.930E+0002
75
        20
            2.117E+0004
                         · 1.349E+0004
                                        2.930E+0002
                          1.400E+0004
    2
        21
            2.117E+0004
76
                                        2.930E+0002
    2
        22
            2.117E+0004
                          1.451E+0004
77
    2
        23
            2.117E+0004
                          1.501E+0004
                                        2.920E+0002
78
                                        2.920E+0002
                          1.548E+0004
            2.117E+0004
79
        24
                                        2.920E+0002
                          1.599E+0004
            2.117E+0004
        25
80
```

***** SPECIFIED FLUX NODES ****

Number of flux nodes: 0

***** SURFACE WATER BODIES ****

Number of surface water body nodes: 0

***** AQUIFER PROPERTIES *****

Number of different material properties: 1

No. Kxx Kyy Porosity [ft/d] [ft/d] [-]

1 3.800E-0001 3.800E-0001 5.000E-0003 (default)

****** DISTRIBUTION OF AQUIFER MATERIAL PROPERTIES *******

1 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	1 1	1 2	7	4	-5	6	7	- 8	9	-10	11	12	-13	14	15	16	17
---------------------------------------	-----	-----	---	---	----	---	---	-----	---	-----	----	----	-----	----	----	----	----

27	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
26	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
25	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
24	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
23	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
22	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
21	1	1	*	*	*	*	*	*	*	*	· *	*	*	*	*	1	1
20	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*	1	1
19	1	1	*	*	*	*	*	*	*	*	*	*	*	1	1	1	1
18	1	1	1	*	*	*	*	*	*	*	*	*	*	1	1	1	1
17	1	1	1	*	*	*	*	*	*	*	*	*	1	1	1	1	1
16	1	1	1	1	*	*	*	*	*	*	*	1	1	1	1	1	1
15	1	1	1	1	1	*	*	*	*	*	1	1	1	1	1	1	1
14	1	1	1	1	1	1	*	*	*	1	1	1	1	1	1	1	1
13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11	1	1	1	1	1	. 1	1	1	1	1	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

| 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

******* DISTRIBUTION OF AQUIFER MATERIAL PROPERTIES ******** (continued)

18 19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
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·																		
27	*	*	*	*	*	*	1	1	1	1	1	1	1	1	1	1	1	
26	*	*	*	*	*	*	1	1	1	1	1	1	1	1	1	1	1	
25	*	*	*	*	*	*	1	1	1	1	1	1	1	1	1	1	1	
24	*	*	*	*	1	1	1	1	1	1	1	1	1	1	1	1	1	
23	*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
22	*	1	1	1	1	1	1	1	1	1	1 ·	1	1	1	1	1	1	
21	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
19	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
18	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
17	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
16	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
15	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	• 1	
9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
1	1	1	1	1	. 1	1	1	1	1	1	1	1	1	1	1	1	1	

***** AQUIFER TYPE *****

Unconfined aquifer

***** AQUIFER BOTTOM ELEVATIONS *****

Number of different aquifer bottom elevations: 1

No. aquifer bottom elevation [ft]

1 1.000E+0002 (default)

****** DISTRIBUTION OF AQUIFER BOTTOM ELEVATIONS *******

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
--	---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	--

27	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
26	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
25	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
24	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
23	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
22	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
21	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*	1	1
20	1	1	*	*	*	. *	*	*	*	*	*	*	*	*	*	1	1
19	1	1	*	*	*	*	*	*	*	*	*	*	*	1	1	1	1
18	1	1	1	*	*	*	*	*	*	*	*	*	*	1	1	1	1
17	1	1	1	*	*	*	*	*	*	*	*	*	1	1	1	1	. 1
16	1	1	1	1	*	*	*	*	*	*	*	1	1	1	1	1	1
15	1	1	1	1	1	*	*	*	*	*	1	1	1	1	1	1	1
14	1	1	1	1	1	1	*	*	*	1	1	1	1	1	1	1	1
13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8	1	1	1	1	`1	1	1	1	1	1	1	1	1	1	1	1	1
7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

^{1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17}

******* DISTRIBUTION OF AQUIFER BOTTOM ELEVATIONS ******** (continued)

1 18 19 20 21 22 23 24 25 26 27 28 29 30 31 3	118	9 20 21	22 23	24 25	5 26	2.7	28	29	30	31	32	33	34
---	-----	---------	-------	-------	------	-----	----	----	----	----	----	----	----

27	*	*	*	*	*	*	1	1	1	1	1	1	1	1	1	1	1	
26	*	*	*	*	*	*	1	1	1	1	1	1	1	1	1	1	1	
25	*	*	*	*	*	*	1	1	1	1	1	1	1	1	1	1	1	
24	*	*	*	*	1	1	1	1	1	1	1	1	1	1	1	1	1	
23	*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
22	*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
21	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
19	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
18	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
17	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
16	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
15	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	٠ 1	1	
12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	•
9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
7 [1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
1	1	1	1	1	. 1	1	1	1	1	1	1	1	1	1	1	1	1	

***** AREAL RECHARGE *****

Number of different infiltration/evapotranspiration rates: 1

No. infiltration evapotranspiration effective recharge [L/T] [L/T] [L/T]

1 0.000E+0000 0.000E+0000 0.000E+0000 (default)

******* DISTRIBUTION OF AREAL IN/OUT-FLUXES *******

1 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16	1 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	1
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27	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
26	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
25	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
24	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
23	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
22	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
21	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*	1	1	
20	1	1	*	*	*	*	*	*	*	*	*	*	*	*	*	1	1	
19	1	1	*	*	*	*	*	*	*	*	*	*	*	1	1	1	1	
18	1	1	1	*	*	*	*	*	*	*	*	*	*	1	1	1	1	
17	1	1	1	*	*	*	*	*	*	*	*	*	1	1	1	1	1	
16	1	1	1	1	*	*	*	*	*	*	*	1	1	1	1	1	1	
15	1	1	1	1	1	*	*	*	*	*	1	1	1	1	1	1	1	
14	1	1	1	1	1	1	*	*	*	1	1	1	1	1	1	1	1	
13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	

| 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

******* DISTRIBUTION OF AREAL IN/OUT-FLUXES ******** (continued)

18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

27 * * * * * * * * * * * * * * * 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1																		
26 * * * * * * * * * * * * * * * * * 1 1	27	*	*	*	*	*	*	1	1	1	1	1	1	1	1	1	1	1
25 * * * * * * * * * * 1		*	*	*	*	*	*	1	1	1	1	1	1	1	1	1	1	1
24 * * * * * * 1 1 1 1 1 1 1 1 1 1 1 1 1		*	*	*	*	*	*	1	1	1	1	1	1	1	1	1	1	1
22 * 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		*	*	*	*	1	1	1	1	1	1	1	1	1	1	1	1	1
22 * 1	23	*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
21 1		*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
19 1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
18 1 1 <td>20</td> <td>1</td> <td></td>	20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
17 1	19	1	1	1	1	1	1	1	1	1	1	1	1	1		1		
16 1	18	1	1	1	1	1	1	1	1	1	1	1						
15 1 1 <td>17</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	17	1	1	1	1	1	1	1	1	1								
14 1	16	1	1	1	1	1	1	1	1	1	1							
13 1	15	1	1	1	1	1	1		1									
12 1	14	1	1	1	1	1	1		1									
11 1	13	1	1	1	1	1												
10 1	12	1	1	1	1	1												
9 1	11	1	1		1	1												
8 1 1	10	1	1															
7 1	9	1																
6 1	8	1	1	1														
5 1 1	7	1																
4 1 1	6	1																
3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	5																	
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		•																
	3	•																
		1																
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	i	I	1	1

| 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34

***** PATHLINE & PARTICLE TRACKING DATA *****

Number of forward particles: 0 Number of reverse particles: 32

No.	x-release	y-release
1	3.111E+0004	7.531E+0003
2	3.272E+0004	7.810E+0003
3	3.277E+0004 3.277E+0004	7.864E+0003
<i>3</i>	3.286E+0004	7.864E+0003
5	3.291E+0004	7.783E+0003
<i>5</i>	3.291E+0004 3.291E+0004	7.702E+0003
7	3.286E+0004	7.675E+0003
8	3.277E+0004	7.675E+0003
	3.277E+0004 3.272E+0004	7.729E+0003
9	3.272E+0004 3.113E+0004	7.486E+0003
10		9.106E+0003
11	3.029E+0004 3.035E+0004	9.106E+0003 9.052E+0003
12		
13	3.035E+0004	8.962E+0003 8.899E+0003
14	3.028E+0004	
15	3.017E+0004	8.899E+0003
16	3.011E+0004	8.953E+0003
17	3.011E+0004	9.034E+0003
18	3.019E+0004	9.097E+0003
19	2.942E+0004	7.019E+0003
20	2.937E+0004	7.046E+0003
21	2.928E+0004	7.046E+0003
22	2.924E+0004	7.010E+0003
23	2.924E+0004	6.929E+0003
24	2.928E+0004	6.875E+0003
25	2.937E+0004	6.875E+0003
26	2.940E+0004	6.929E+0003
27	3.109E+0004	7.603E+0003
28	3.116E+0004	7.657E+0003
29	3.124E+0004	7.657E+0003
30	3.129E+0004	7.594E+0003
31	3.129E+0004	7.522E+0003
32	3.123E+0004	7.486E+0003

Particles released at wells:

Well-No.	Particles	release
1	0	
2	0	
3	0	
4	0	

*****	HYDRAULIC	HEAD	DISTRIBUTION	*****

•

	1	2 3	4	5 6		
27	*	* *	*	*	*	
26	*	* *	*	*	*	
	2.92E+0002	2.92E+0002	*	* *	*	
24	2.92E+0002	2.92E+0002	*	* *	*	
23	2.92E+0002	2.92E+0002	*	* *	*	
22	2.93E+0002	2.93E+0002	*	* *	*	
21	2.93E+0002	2.93E+0002	*	* *	*	
20	2.93E+0002	2.93E+0002	*	* *	*	
19	2.93E+0002	2.93E+0002	*	* *	*	
18	2.94E+0002	2.93E+0002	2.93E+0002	*	* *	
17	2.94E+0002	2.94E+0002	2.94E+0002	* .	* *	
16	2.95E+0002	2.95E+0002	2.95E+0002	2.94E+0002	*	*
15	2.96E+0002	2.96E+0002	2.95E+0002	2.95E+0002	2.94E+0002	*
14	2.97E+0002	2.97E+0002	2.96E+0002	2.96E+0002	2.95E+0002	2.95E+0002
13	2.98E+0002	2.98E+0002	2.98E+0002	2.97E+0002	2.96E+0002	2.95E+0002
12	2.99E+0002	2.99E+0002	2.99E+0002	2.99E+0002	2.98E+0002	2.97E+0002
11	3.01E+0002	3.01E+0002	3.00E+0002	3.00E+0002	3.00E+0002	2.99E+0002
10	3.02E+0002	3.02E+0002	3.02E+0002	3.02E+0002	3.01E+0002	3.01E+0002
9	3.04E+0002	3.04E+0002	3.04E+0002	3.03E+0002	3.03E+0002	3.03E+0002
8	3.04E+0002	3.04E+0002	3.04E+0002	3.04E+0002	3.04E+0002	3.04E+0002
7	3.05E+0002	3.05E+0002	3.05E+0002	3.05E+0002	3.05E+0002	3.04E+0002
6	3.05E+0002	3.05E+0002	3.05E+0002	3.05E+0002	3.05E+0002	3.05E+0002
5	3.07E+0002	3.07E+0002	3.07E+0002	3.07E+0002	3.07E+0002	3.07E+0002
4	3.07E+0002	3.07E+0002	3.07E+0002	3.07E+0002	3.07E+0002	3.07E+0002
3	3.09E+0002	3.09E+0002	3.09E+0002	3.09E+0002	3.08E+0002	3.08E+0002
2	3.10E+0002	3.10E+0002	3.10E+0002	3.10E+0002	3.10E+0002	3.10E+0002
1	3.12E+0002	3.12E+0002	3.12E+0002	3.12E+0002	3.12E+0002	3.12E+0002
	1	2 3	4	5	5	

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******* HYDRAULIC HEAD DISTRIBUTION ******** (continued)

	7	8 9	10	11 1	2	
27	 *	* *	*	*	*	
26	•	* *	*	*	*	
25	•	* *	*	*	*	
24	 *	* *	*	*	*	
23	ı *	* *	*	*	*	
22	, *	* *	*	*	*	
21	*	* *	*	*	*	
20	' *	* *	*	*	*	
19	*	* *	*	*	*	
18	*	* *	*	*	*	
17	*	* *	*	*	*	
16	*	* *	*	* 2.9	95E+0002	
15	*	* *	*	2.95E+0002	2.95E+0002	
14	*	* *	2.95E+00	002 2.95E+00	002 2.95E+00	02
13	2.95E+0002	2.95E+0002	2.95E+0002	2.96E+0002	2.96E+0002	2.95E+0002
12	2.97E+0002	2.97E+0002	2.97E+0002	2.97E+0002	2.97E+0002	2.96E+0002
11	2.99E+0002	2.99E+0002	2.99E+0002		2.98E+0002	2.97E+0002
10	3.01E+0002	3.01E+0002		3.00E+0002	2.99E+0002	2.98E+0002
9	3.03E+0002	3.02E+0002		3.02E+0002	3.01E+0002	
8	3.04E+0002	3.03E+0002		3.02E+0002		
7	3.04E+0002	3.04E+0002		3.03E+0002	3.02E+0002	3.01E+0002
6		3.04E+0002		3.03E+0002	3.03E+0002	3.02E+0002
5	3.06E+0002	3.06E+0002		3.05E+0002	3.05E+0002	3.04E+0002
4	3.07E+0002	3.06E+0002		3.06E+0002	3.05E+0002	3.04E+0002
3			3.08E+0002	3.08E+0002	3.07E+0002	3.07E+0002
2		3.10E+0002	3.10E+0002	3.10E+0002	3.10E+0002	3.09E+0002
1	3.12E+0002	3.12E+0002	3.12E+0002	3.12E+0002	3.12E+0002	3.12E+0002
	7	8 9	10	11 1	12	

******* HYDRAULIC HEAD DISTRIBUTION ******** (continued)

İ	13	14	15	16		17	18			
27	 *	*	*	*		*	*			
26	,	*	*	*		*	*			
25	 *	*	*	*		*	*			
24	 *	*	*	*		*	*			
23	! *	*	*	*		*	*			
22	! *	*	*	*		*	*			
21	' *	*	*	2.96E+	0002	2.96E-	+0002	2.96E-	⊦000	2
20	' *	*	*	2.96E+	0002	2.96E-	+0002	2.95E-	- 000	2
19	* 2.9	95E+0002	2.9	5E+0002	2.95E	+0002	2.95E	+0002	2.95	5E+0002
18	* 2.9	95E+0002	2.9	5E+0002	2.94E	+0002	2.94E	+0002	2.94	4E+0002
17	2.95E+0002	2.95E+00	02	2.94E+000)2 2.9	94E+00	02 2.	93E+00	02	2.93E+0002
16	2.95E+0002	2.94E+00	02	2.93E+000	2.9	93E+00	02 2.	92E+00	02	2.92E+0002
15	2.94E+0002	2.94E+00	02	2.93E+000	02 2.9	92E+00	02 2.	91E+00		2.91E+0002
14	2.94E+0002	2.93E+00	02	2.92E+000)2 2.9	91E+00	02 2.	90E+00	02	2.89E+0002
13	2.94E+0002	2.93E+00	02	2.92E+000)2 2.9	90E+00	02 2.	89E+00		2.87E+0002
12	2.95E+0002	2.93E+00	02	2.91E+000	02 2.8	89E+00		87E+00		2.85E+0002
11	2.96E+0002	2.94E+00	02	2.91E+000		88E+00		86E+00		2.82E+0002
10	2.97E+0002	2.95E+00		2.92E+000		89E+00		88E+00		2.85E+0002
9	2.98E+0002	2.96E+00		2.94E+000		0E+00		89E+000		2.88E+0002
8	2.99E+0002	2.97E+00		2.94E+000		1E+00		90E+00		2.89E+0002
7		2.98E+00		2.95E+000		1E+00		90E+00		2.89E+0002
6	3.00E+0002	2.98E+00		2.95E+000		2E+00		90E+00		2.90E+0002
5		3.01E+00		2.98E+000		92E+00		88E+00		2.92E+0002
4	3.03E+0002	3.01E+00		2.98E+000		92E+00		87E+00		2.92E+0002
3	3.06E+0002	3.04E+00		3.02E+000		9E+00		98E+00		2.99E+0002
	3.09E+0002	3.08E+00		3.07E+000		6E+00	-	06E+00		3.06E+0002
1	3.12E+0002	3.12E+00	02	3.12E+000)2 3.1	2E+00	02 3. 	12E+00	02 :	3.12E+0002
	13	14	15	16		17	18			

******* HYDRAULIC HEAD DISTRIBUTION ********* (continued)

1	19	20 21	22	23	24	
27	*	* *	*	* 2.9	97E+0002	
26		* *	*	* 2.9	97E+0002	
25		* *	*	* 2.9	97E+0002	
24	*	* *	2.96E+00	02 2.97E+00	02 2.97E+00	02
23	2.96E+0002	2.96E+0002	2.96E+0002	2.96E+0002	2.96E+0002	2.96E+0002
22	2.96E+0002	2.96E+0002	2.96E+0002	2.96E+0002	2.96E+0002	2.96E+0002
21	2.96E+0002	2.96E+0002	2.96E+0002	2.96E+0002	2.96E+0002	2.96E+0002
20	2.95E+0002	2.95E+0002	2.95E+0002	2.95E+0002	2.95E+0002	2.96E+0002
19	2.95E+0002	2.95E+0002	2.95E+0002	2.95E+0002	2.95E+0002	2.95E+0002
18	2.94E+0002	2.94E+0002	2.94E+0002	2.94E+0002	2.94E+0002	2.95E+0002
17	2.93E+0002	2.93E+0002	2.93E+0002	2.93E+0002	2.94E+0002	2.94E+0002
16	2.92E+0002	2.92E+0002	2.92E+0002	2.92E+0002	2.93E+0002	2.94E+0002
	2.91E+0002	2.91E+0002	2.91E+0002	2.91E+0002	2.92E+0002	2.93E+0002
14	2.89E+0002	2.89E+0002	2.90E+0002	2.90E+0002	2.91E+0002	2.93E+0002
13	2.86E+0002	2.87E+0002	2.88E+0002	2.89E+0002	2.90E+0002	2.92E+0002
12	2.81E+0002	2.84E+0002	2.86E+0002	2.87E+0002	2.89E+0002	2.91E+0002
11	2.71E+0002	2.81E+0002	2.84E+0002	2.86E+0002	2.88E+0002	2.91E+0002
10	2.81E+0002	2.83E+0002	2.84E+0002	2.85E+0002	2.88E+0002	2.90E+0002
9	2.85E+0002	2.85E+0002	2.84E+0002	2.85E+0002	2.88E+0002	2.88E+0002
8	2.87E+0002	2.85E+0002	2.82E+0002	2.85E+0002	2.89E+0002	2.89E+0002
7	2.88E+0002	2.86E+0002	2.78E+0002	2.85E+0002	2.90E+0002	2.90E+0002
6	2.89E+0002	2.87E+0002	2.83E+0002	2.85E+0002	2.90E+0002	2.91E+0002
5	2.94E+0002	2.93E+0002	2.93E+0002	2.93E+0002	2.96E+0002	2.97E+0002
4	2.94E+0002	2.94E+0002	2.94E+0002	2.94E+0002	2.96E+0002	2.97E+0002
	3.00E+0002	3.00E+0002	3.00E+0002	3.00E+0002	3.01E+0002	3.02E+0002
2	3.06E+0002	3.06E+0002	3.06E+0002	3.06E+0002	3.07E+0002	3.07E+0002
1	3.12E+0002	3.12E+0002	3.12E+0002	3.12E+0002	3.12E+0002	3.12E+0002
	19	20 2	1 22	23	24	

******* HYDRAULIC HEAD DISTRIBUTION ********* (continued)

1	25	26 27	7 28	29	30	
27	2.97E+0002	2.96E+0002	2.96E+0002	2.96E+0002	2.96E+0002	2.95E+0002
26	2.97E+0002	2.97E+0002	2.96E+0002	2.96E+0002	2.96E+0002	2.96E+0002
25	2.97E+0002	2.97E+0002	2.96E+0002	2.96E+0002	2.96E+0002	2.96E+0002
24	2.97E+0002	2.97E+0002	2.96E+0002	2.96E+0002	2.96E+0002	2.96E+0002
23	2.96E+0002	2.96E+0002	2.96E+0002	2.96E+0002	2.96E+0002	2.96E+0002
	2.96E+0002	2.96E+0002	2.96E+0002	2.96E+0002	2.96E+0002	2.97E+0002
21	2.96E+0002	2.96E+0002	2.96E+0002	2.96E+0002	2.97E+0002	2.97E+0002
	2.96E+0002	2.96E+0002	2.96E+0002	2.96E+0002	2.97E+0002	2.97E+0002
19	2.95E+0002	2.96E+0002	2.96E+0002	2.96E+0002	2.97E+0002	2.97E+0002
18		2.95E+0002	2.96E+0002	2.96E+0002	2.97E+0002	2.97E+0002
17	2.95E+0002	2.95E+0002	2.96E+0002	2.97E+0002	2.97E+0002	2.98E+0002
	2.94E+0002	2.95E+0002	2.96E+0002	2.97E+0002	2.97E+0002	2.98E+0002
	2.94E+0002	2.95E+0002	2.96E+0002	2.97E+0002	2.98E+0002	2.99E+0002
14	2.94E+0002	2.94E+0002	2.96E+0002	2.97E+0002	2.98E+0002	2.99E+0002
13	2.93E+0002	2.94E+0002	2.96E+0002	2.97E+0002	2.99E+0002	3.00E+0002
	2.92E+0002	2.93E+0002	2.96E+0002	2.98E+0002	2.99E+0002	3.01E+0002
11	2.92E+0002	2.93E+0002	2.96E+0002	2.98E+0002	3.00E+0002	3.02E+0002
10	2.91E+0002	2.92E+0002	2.96E+0002	2.99E+0002	3.01E+0002	3.03E+0002
9	2.88E+0002	2.91E+0002	2.96E+0002	3.00E+0002	3.03E+0002	3.05E+0002
8	2.82E+0002	2.91E+0002	2.97E+0002	3.01E+0002	3.03E+0002	3.05E+0002
7	2.89E+0002	2.92E+0002	2.98E+0002	3.02E+0002	3.04E+0002	3.06E+0002
6	2.91E+0002	2.93E+0002	2.98E+0002	3.02E+0002	3.04E+0002	3.06E+0002
5	2.98E+0002	2.99E+0002	3.02E+0002	3.04E+0002	3.07E+0002	3.08E+0002
4	2.98E+0002	2.99E+0002	3.02E+0002	3.05E+0002	3.07E+0002	3.09E+0002
3	3.03E+0002	3.04E+0002	3.05E+0002	3.07E+0002	3.09E+0002	3.10E+0002
2	3.08E+0002	3.08E+0002	3.09E+0002	3.10E+0002	3.12E+0002	3.12E+0002
1	3.12E+0002	3.12E+0002	3.12E+0002	3.12E+0002	3.12E+0002	3.12E+0002
	25	26 2	7 28	29	30	

******* HYDRAULIC HEAD DISTRIBUTION ********* (continued)

1	31	32 3	3 34	
27	2.95E+0002	2.95E+0002	2.95E+0002	2.95E+0002
	2.95E+0002	2.95E+0002	2.95E+0002	2.95E+0002
	2.96E+0002	2.96E+0002	2.96E+0002	2.96E+0002
24	2.96E+0002	2.96E+0002	2.96E+0002	2.96E+0002
	2.96E+0002	2.96E+0002	2.96E+0002	2.96E+0002
	2.97E+0002	2.97E+0002	2.97E+0002	2.97E+0002
	2.97E+0002	2.97E+0002	2.97E+0002	2.97E+0002
20	2.97E+0002	2.97E+0002	2.97E+0002	2.97E+0002
19	2.97E+0002	2.98E+0002	2.98E+0002	2.98E+0002
18	2.98E+0002	2.98E+0002	2.98E+0002	2.98E+0002
	2.98E+0002	2.99E+0002	2.99E+0002	2.99E+0002
16	2.99E+0002	2.99E+0002	2.99E+0002	3.00E+0002
15	2.99E+0002	3.00E+0002	3.00E+0002	3.00E+0002
14	3.00E+0002	3.01E+0002	3.01E+0002	3.01E+0002
13	3.01E+0002	3.02E+0002	3.02E+0002	3.02E+0002
12	3.02E+0002	3.03E+0002	3.04E+0002	3.04E+0002
11	3.03E+0002	3.04E+0002	3.05E+0002	3.05E+0002
10	3.05E+0002	3.06E+0002	3.07E+0002	3.08E+0002
9	3.06E+0002	3.08E+0002	3.09E+0002	3.10E+0002
8	3.07E+0002	3.09E+0002	3.11E+0002	3.12E+0002
7	3.08E+0002	3.10E+0002	3.12E+0002	3.12E+0002
6	3.08E+0002	3.10E+0002	3.12E+0002	3.12E+0002
	3.10E+0002	3.12E+0002	3.12E+0002	3.12E+0002
	3.10E+0002	3.12E+0002	3.12E+0002	3.12E+0002
	3.12E+0002	3.12E+0002	3.12E+0002	3.12E+0002
	3.12E+0002	3.12E+0002	3.12E+0002	3.12E+0002
1	3.12E+0002	3.12E+0002	3.12E+0002	3.12E+0002
	31	32 3	3 34	

****** End of logbook ********